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Takagi

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(54) **INKJET PRINTER**

(75) Inventor: **Osamu Takagi**, Nagoya (JP)

(73) Assignee: **Brother Kogyo Kabushiki Kaisha**, Nagoya (JP)

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B65H 23/04 (2006.01)

(52) **U.S. Cl.** **347/104**; 226/2; 226/10; 226/27

(58) **Field of Classification Search** .... None
See application file for complete search history.

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Primary Examiner—Andrew H. Hirshfeld
Assistant Examiner—Jill E. Culler
(74) *Attorney, Agent, or Firm*—Oliff & Berridge PLC

(57) **ABSTRACT**

An inkjet printer includes a conveyance belt including a groove, a conveyance mechanism, a cutting mechanism, a control unit, and a judgment unit. After the cutting mechanism cuts the printing medium, The judgment unit judges whether or not a cut position of the printing medium will be located in a predetermined region of the conveyance belt if the conveyance mechanism drives the conveyance belt to convey the printing medium in the direction opposite to the conveyance direction. The predetermined region of the conveyance belt includes the groove. When the judgment unit judges that the cut position of the printing medium will be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing mechanism on the conveyance belt in the conveyance direction and subsequently controls the cutting mechanism to cut the printing medium.

10 Claims, 14 Drawing Sheets

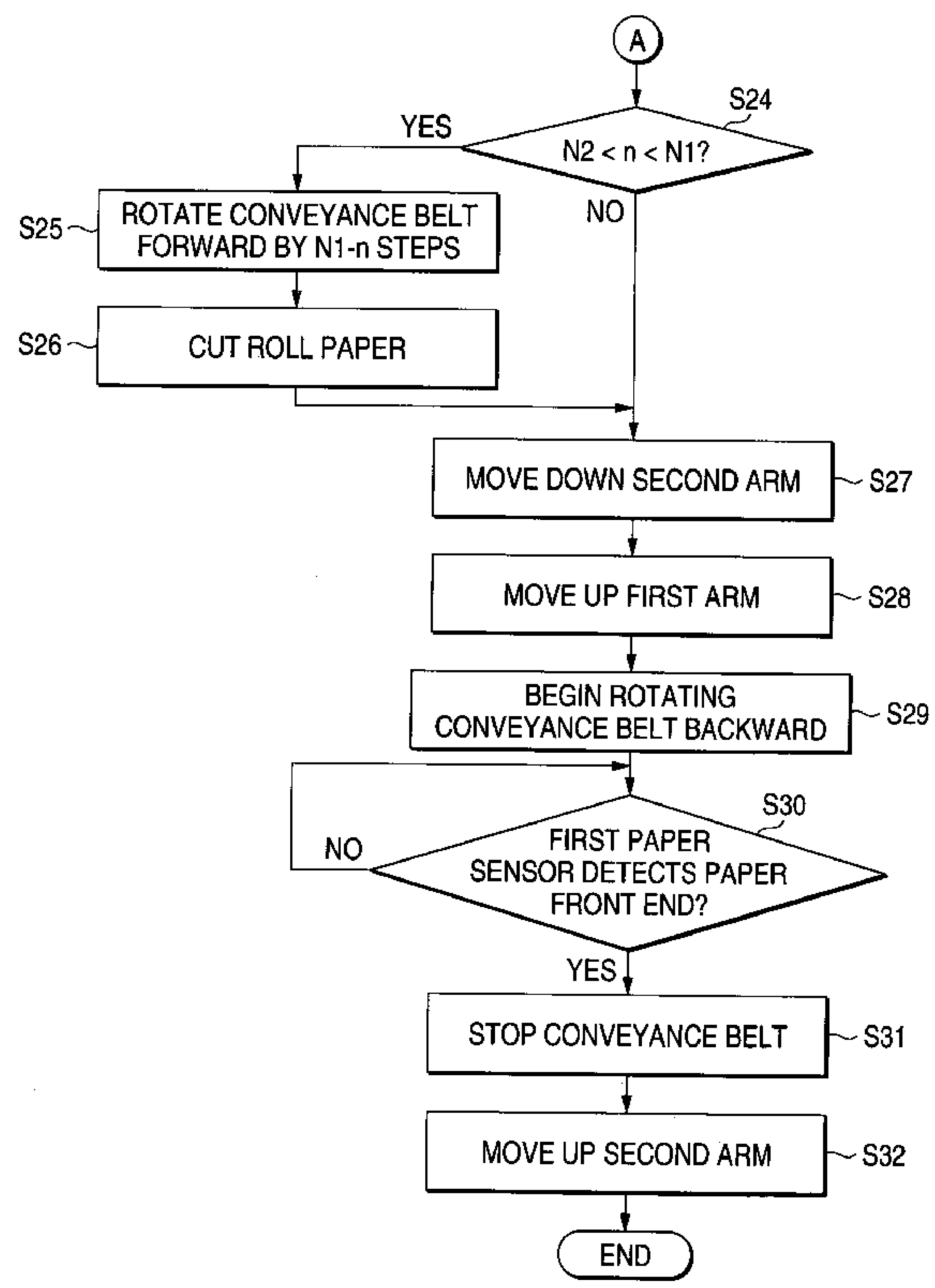
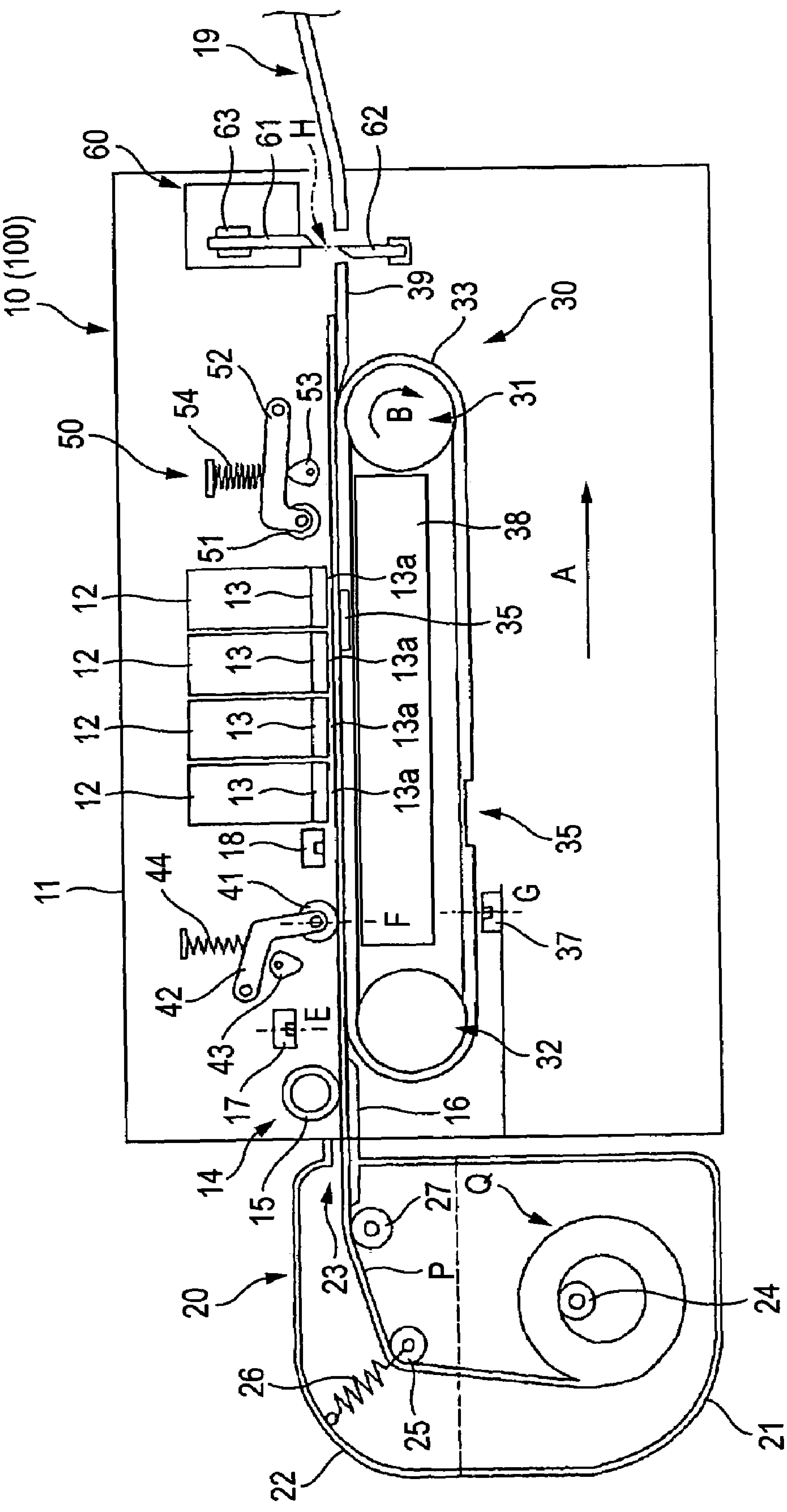


FIG. 1A


10 (100)
11
12
13
13a
14
15
16
17
18
19
20
21
22
23
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27
30
31
32
33
35
37
38
39
41
42
43
44
50
51
52
53
54
60
61
62
63
A
B
E
F
G
H
P
Q

FIG. 1B

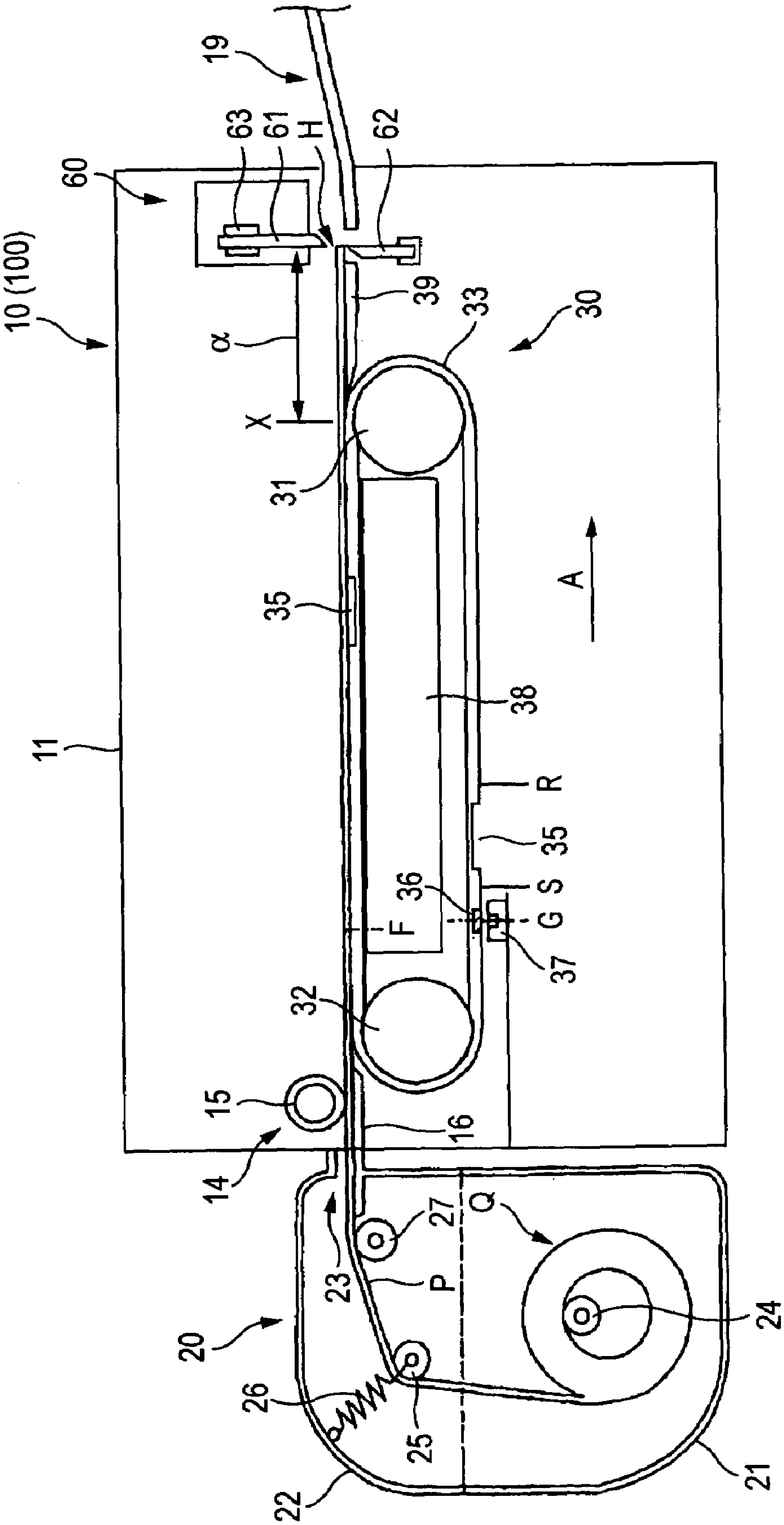

10 (100)
11
14
15
16
19
20
21
22
23
24
25
26
27
30
31
32
33
35
35
36
37
38
39
60
61
62
63
H
α
X
A
R
S
G
F
P
Q

FIG. 1C

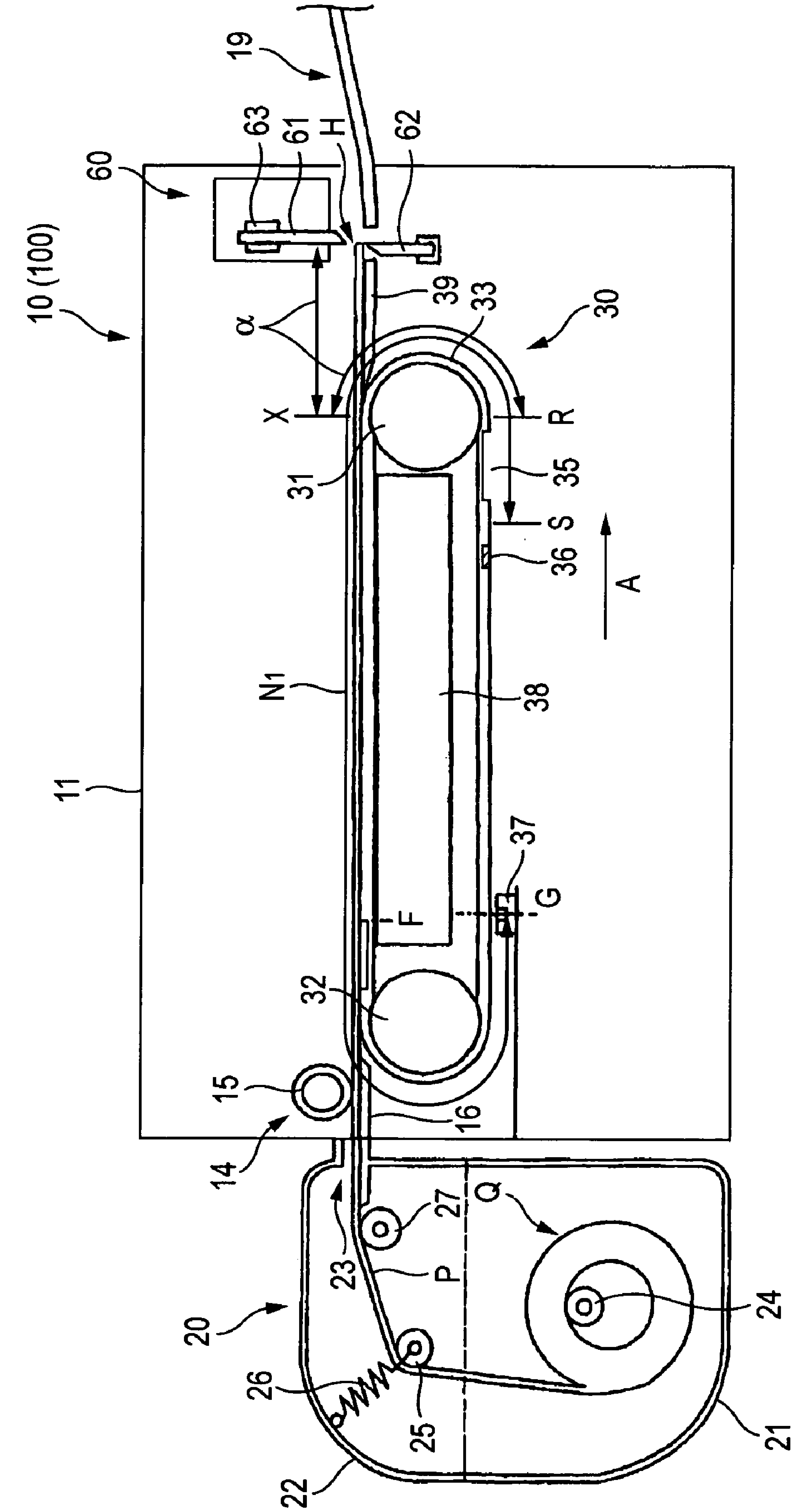
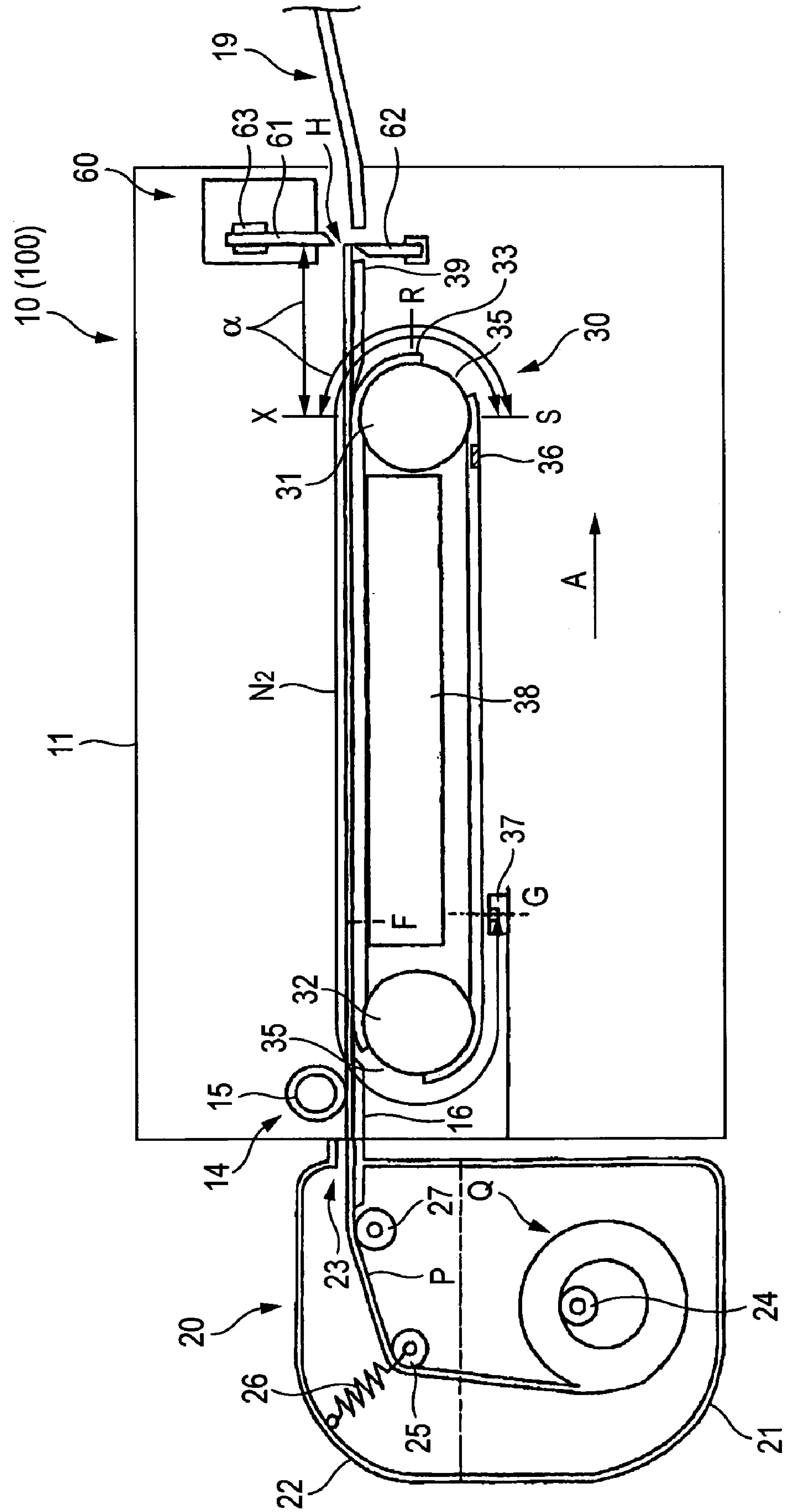

10 (100)
11
14
15
16
19
20
21
22
23
24
25
26
27
30
31
32
33
35
36
37
38
39
60
61
62
63
H
α
X
R
S
A
N1
F
G
P
Q

FIG. 1D



10 (100)
11
14
15
16
19
20
21
22
23
24
25
26
27
30
31
32
33
35
36
37
38
39
60
61
62
63
α
A
F
G
H
N2
P
Q
R
S
X

FIG. 2

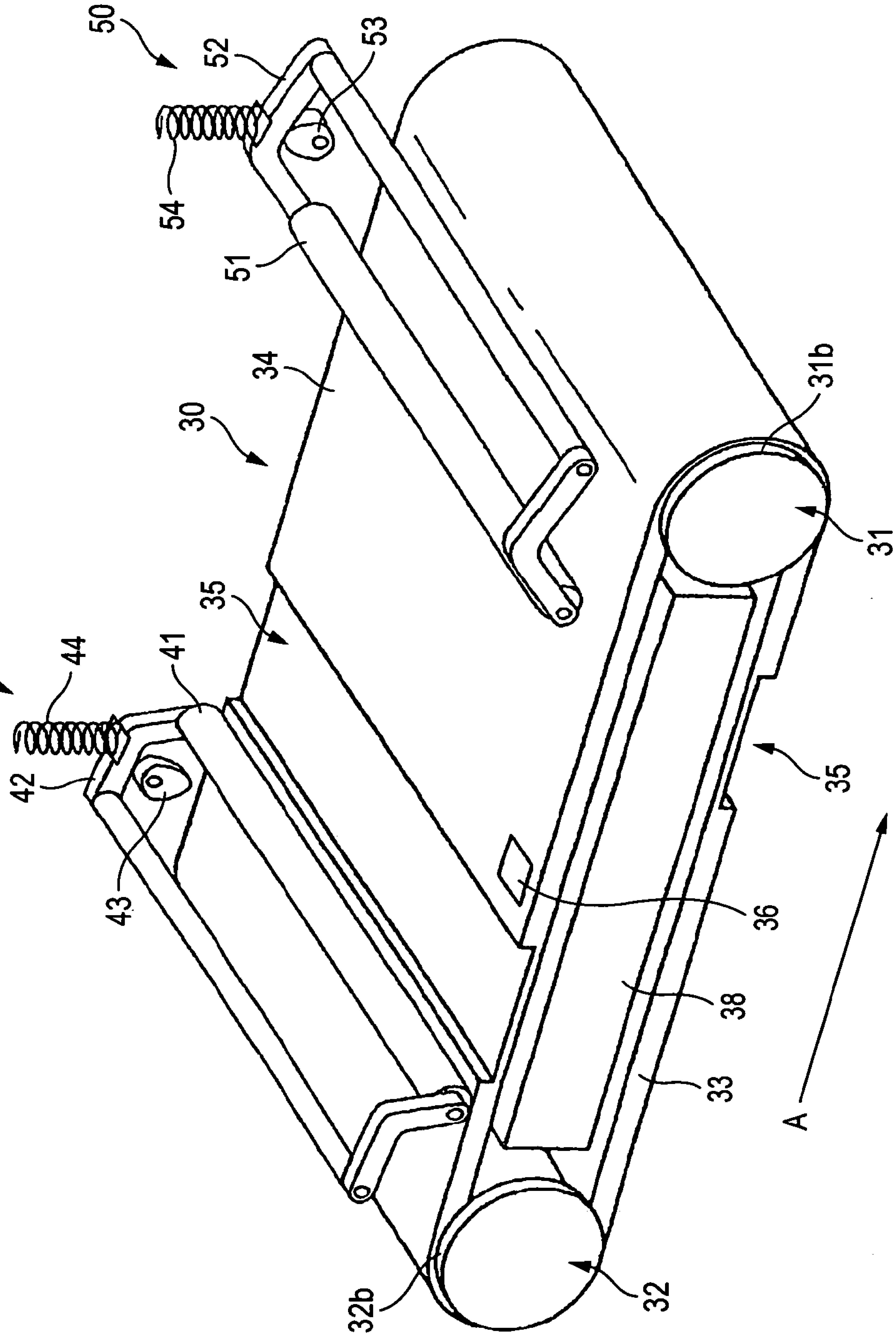


FIG. 3

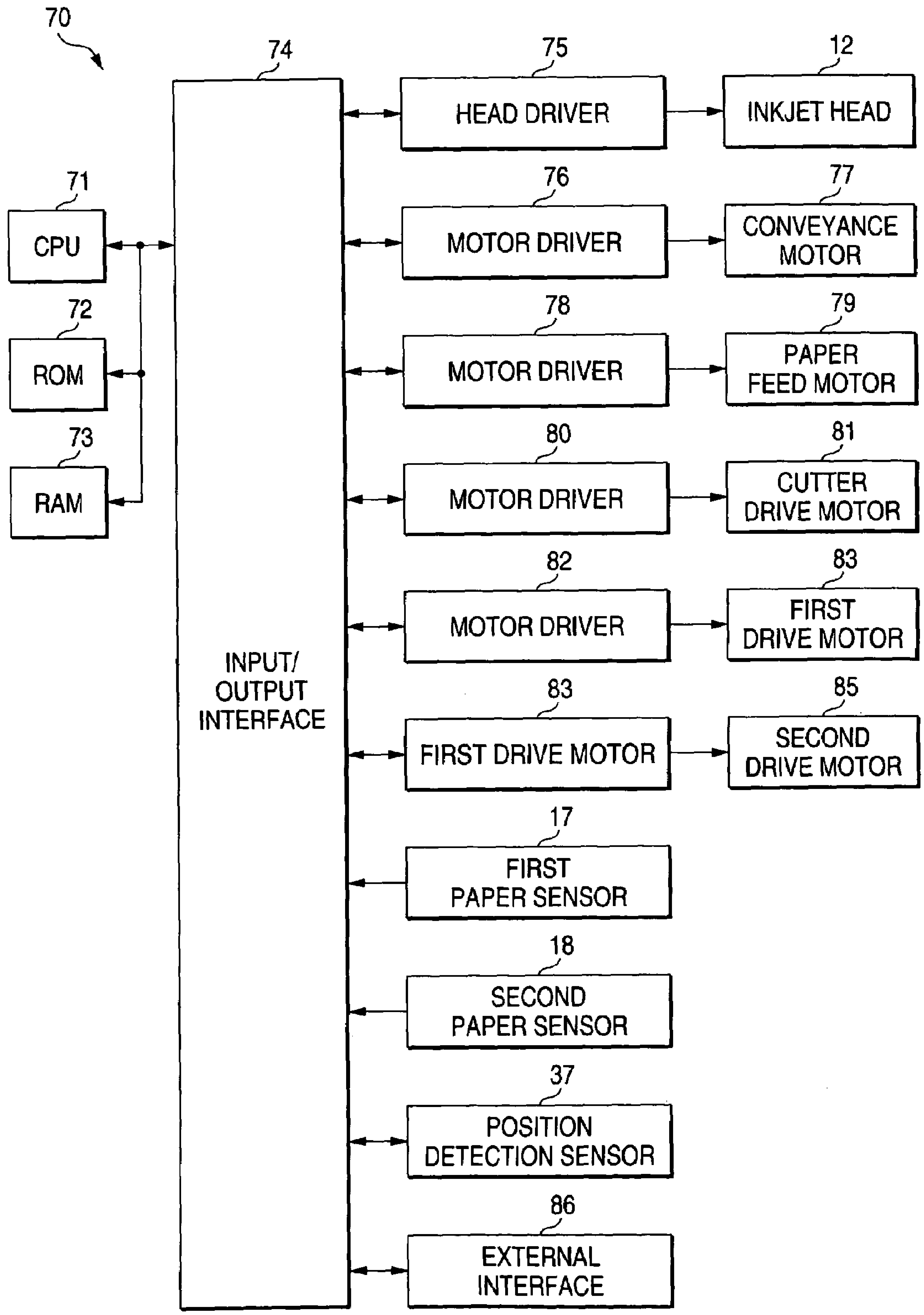

70
74
INPUT/
OUTPUT
INTERFACE
71
CPU
72
ROM
73
RAM
75
HEAD DRIVER
12
INKJET HEAD
76
MOTOR DRIVER
77
CONVEYANCE
MOTOR
78
MOTOR DRIVER
79
PAPER
FEED MOTOR
80
MOTOR DRIVER
81
CUTTER
DRIVE MOTOR
82
MOTOR DRIVER
83
FIRST
DRIVE MOTOR
83
FIRST DRIVE MOTOR
85
SECOND
DRIVE MOTOR
17
FIRST
PAPER SENSOR
18
SECOND
PAPER SENSOR
37
POSITION
DETECTION SENSOR
86
EXTERNAL
INTERFACE

FIG. 4

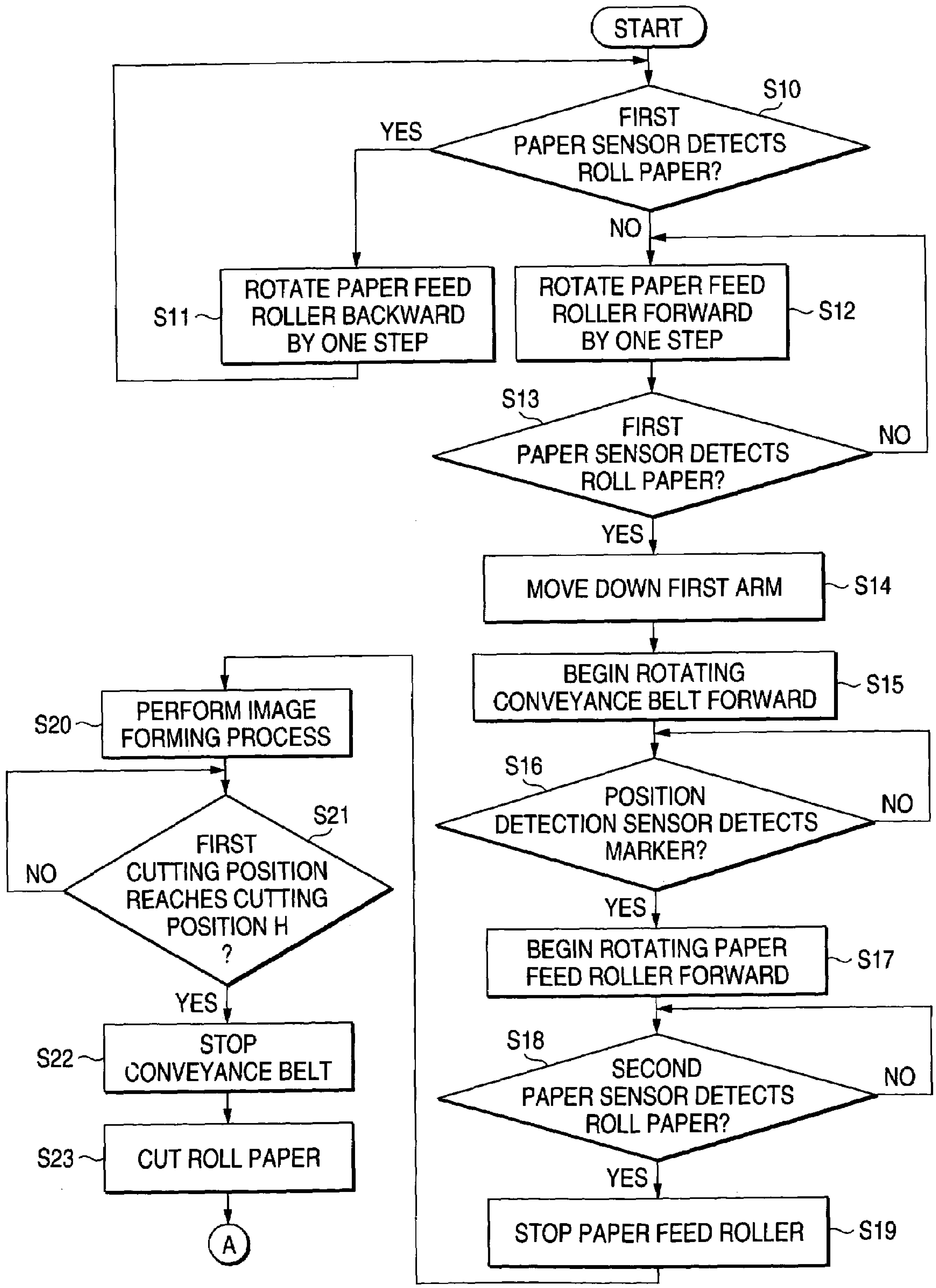

START
FIRST PAPER SENSOR DETECTS ROLL PAPER?
S10
YES
NO
ROTATE PAPER FEED ROLLER BACKWARD BY ONE STEP
S11
ROTATE PAPER FEED ROLLER FORWARD BY ONE STEP
S12
S13
FIRST PAPER SENSOR DETECTS ROLL PAPER?
NO
YES
MOVE DOWN FIRST ARM
S14
BEGIN ROTATING CONVEYANCE BELT FORWARD
S15
S16
POSITION DETECTION SENSOR DETECTS MARKER?
NO
YES
BEGIN ROTATING PAPER FEED ROLLER FORWARD
S17
S18
SECOND PAPER SENSOR DETECTS ROLL PAPER?
NO
YES
STOP PAPER FEED ROLLER
S19
PERFORM IMAGE FORMING PROCESS
S20
S21
FIRST CUTTING POSITION REACHES CUTTING POSITION H ?
NO
YES
STOP CONVEYANCE BELT
S22
CUT ROLL PAPER
S23
A

FIG. 5

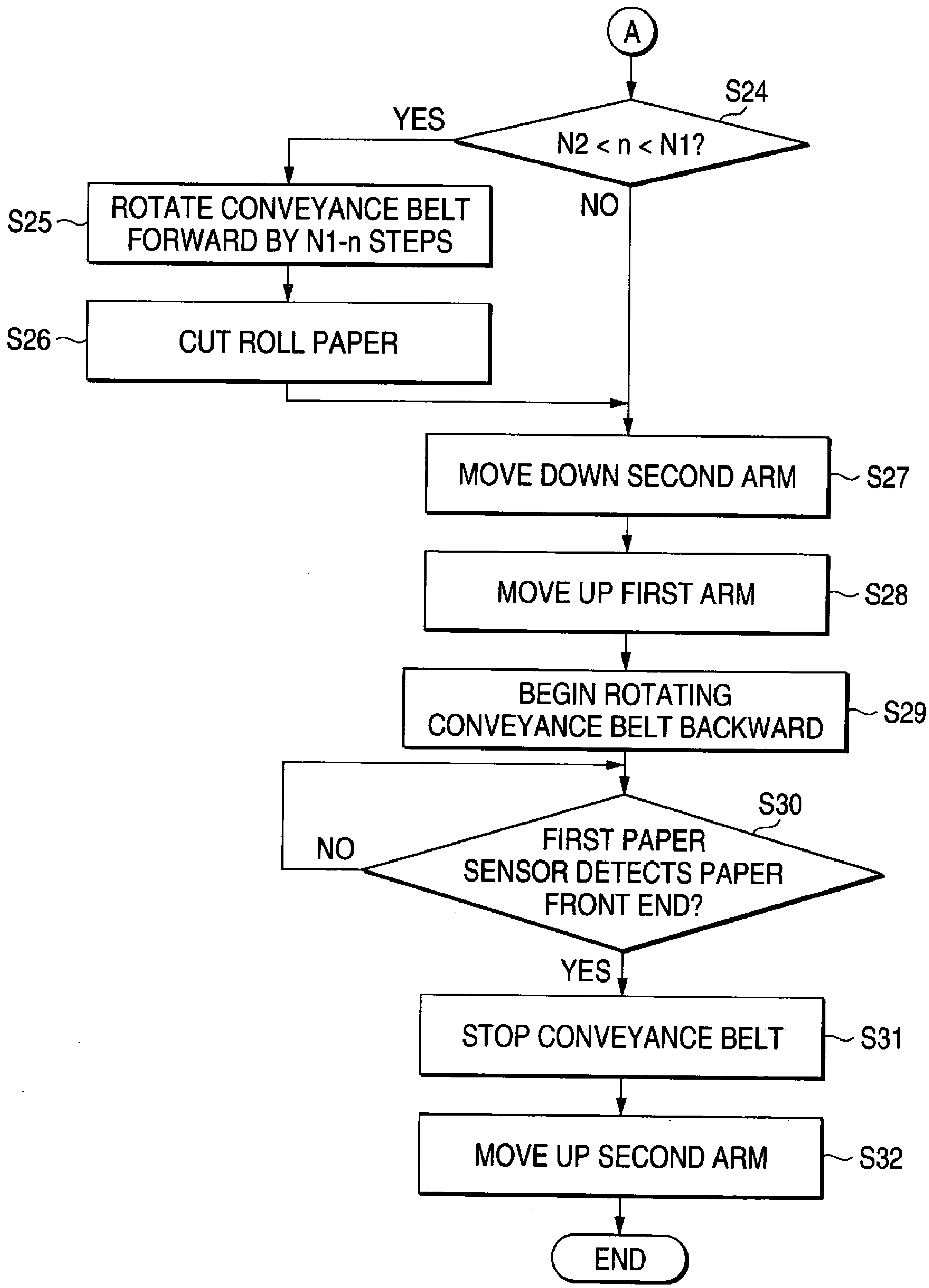

A
S24
N2 < n < N1?
YES
NO
S25
ROTATE CONVEYANCE BELT FORWARD BY N1-n STEPS
S26
CUT ROLL PAPER
MOVE DOWN SECOND ARM
S27
MOVE UP FIRST ARM
S28
BEGIN ROTATING CONVEYANCE BELT BACKWARD
S29
S30
FIRST PAPER SENSOR DETECTS PAPER FRONT END?
NO
YES
STOP CONVEYANCE BELT
S31
MOVE UP SECOND ARM
S32
END

FIG. 6

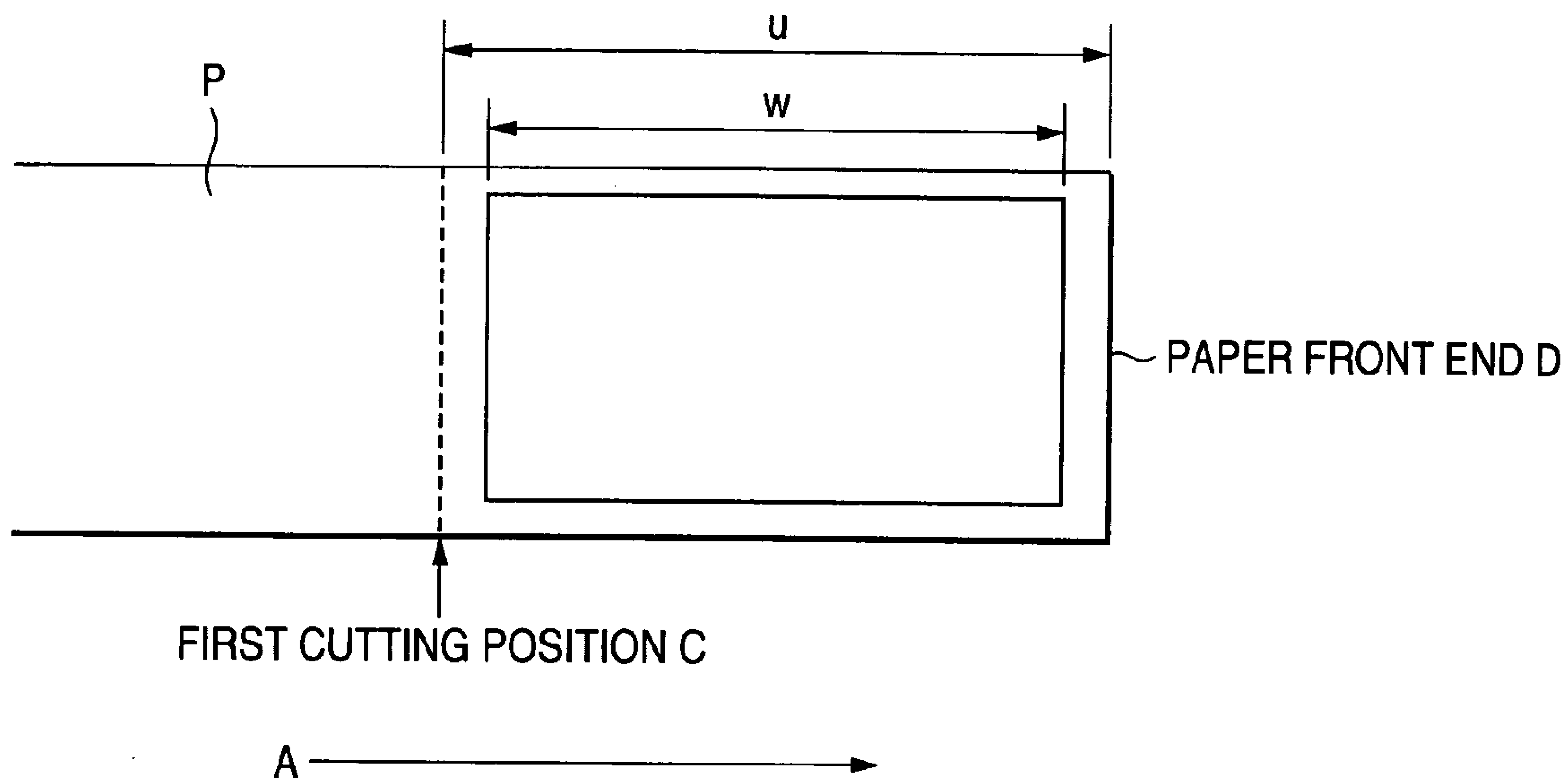


FIG. 7A

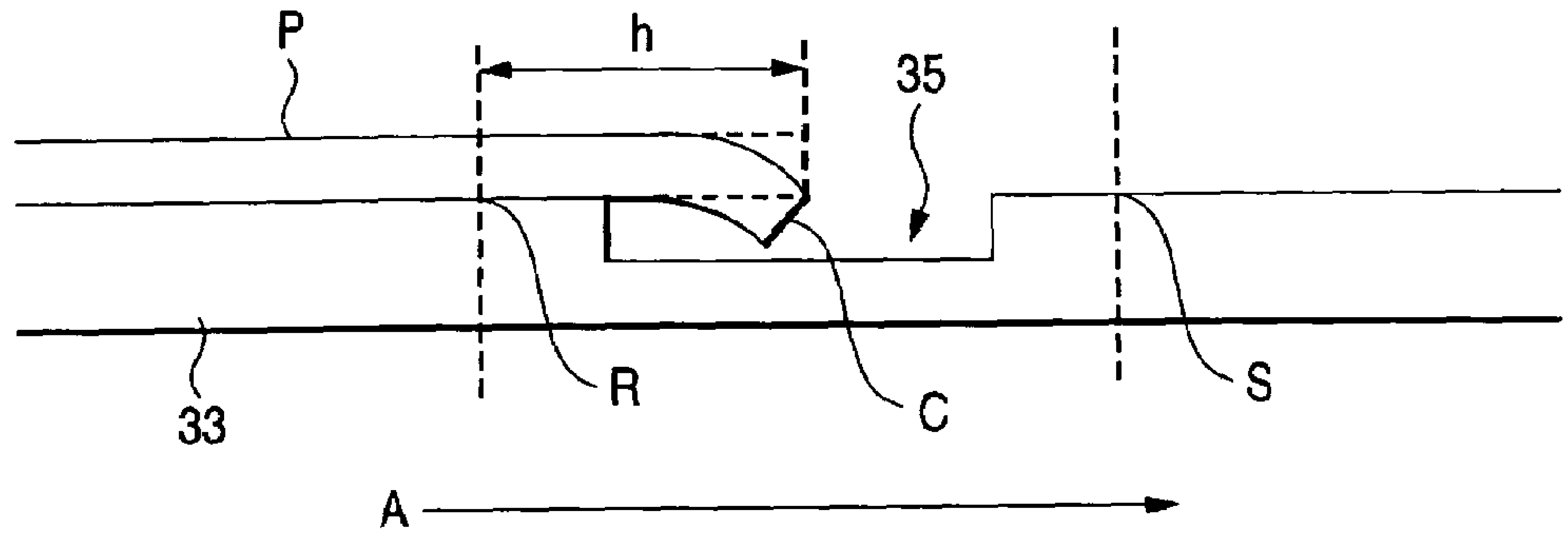


FIG. 7B

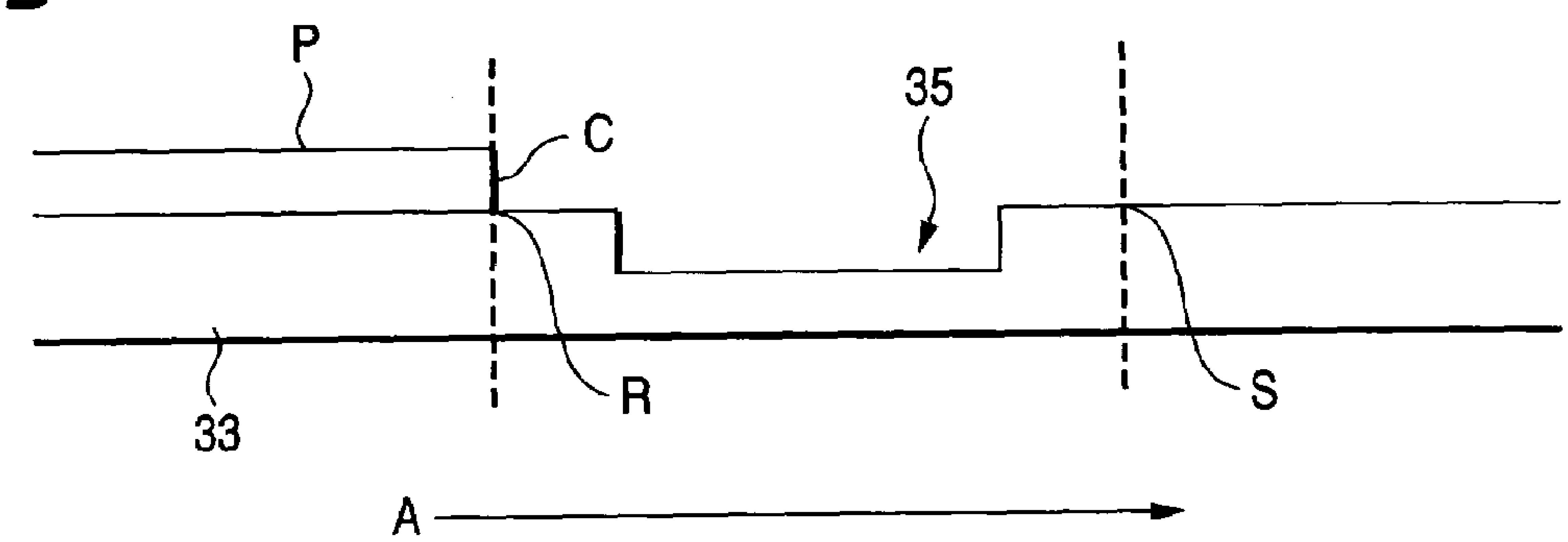


FIG. 7C

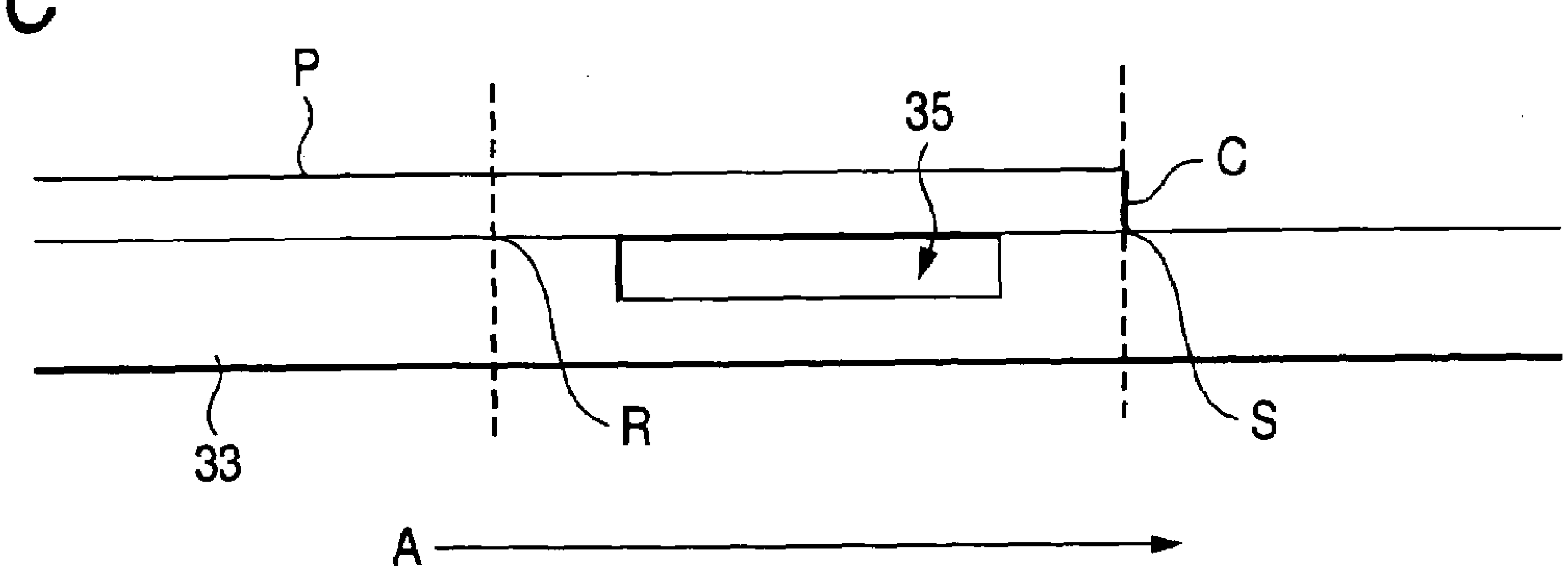


FIG. 8

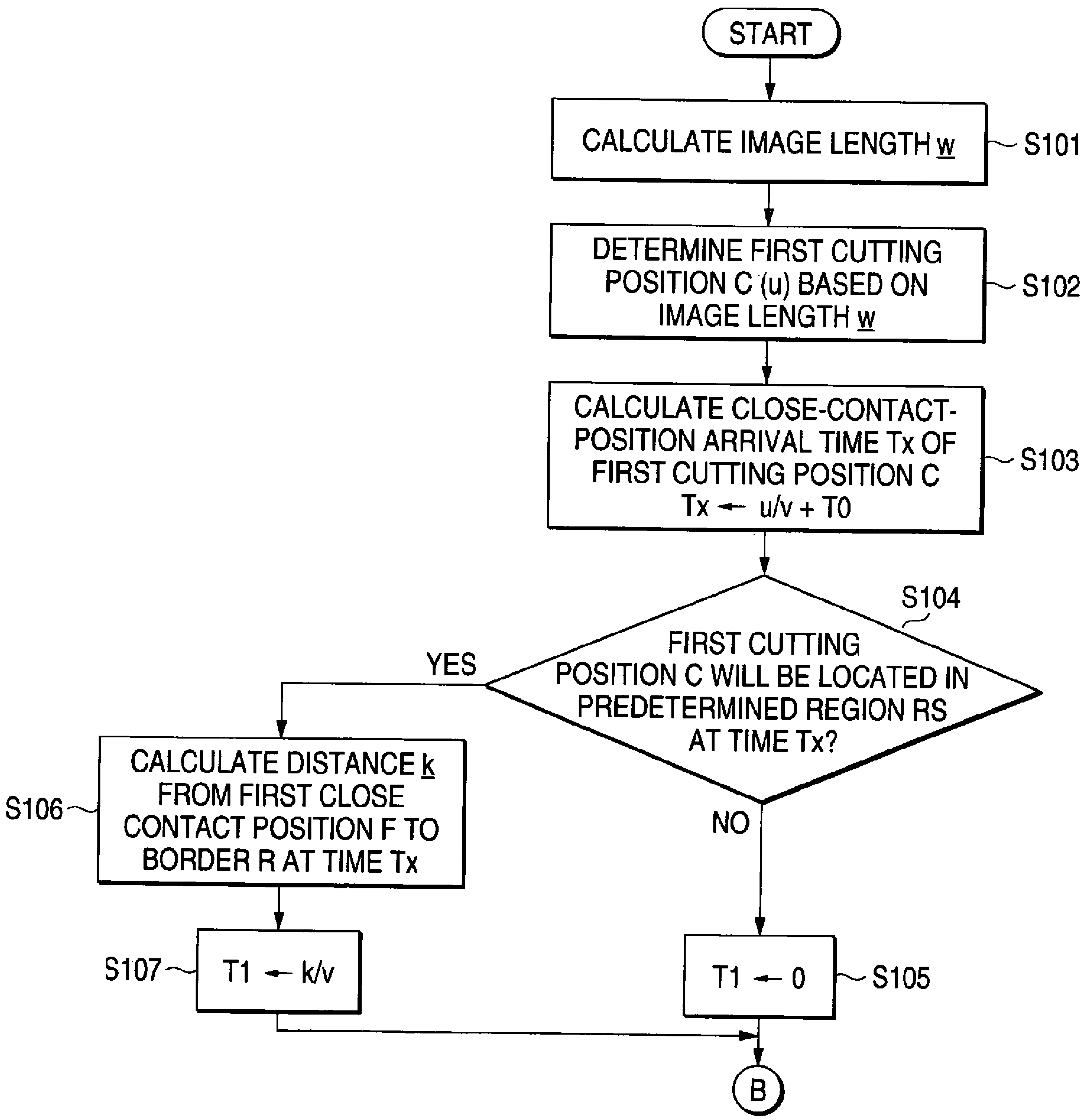

START
CALCULATE IMAGE LENGTH w
S101
DETERMINE FIRST CUTTING POSITION C (u) BASED ON IMAGE LENGTH w
S102
CALCULATE CLOSE-CONTACT-POSITION ARRIVAL TIME Tx OF FIRST CUTTING POSITION C
Tx ← u/v + T0
S103
S104
FIRST CUTTING POSITION C WILL BE LOCATED IN PREDETERMINED REGION RS AT TIME Tx?
YES
NO
CALCULATE DISTANCE k FROM FIRST CLOSE CONTACT POSITION F TO BORDER R AT TIME Tx
S106
S107
T1 ← k/v
T1 ← 0
S105
B

FIG. 9

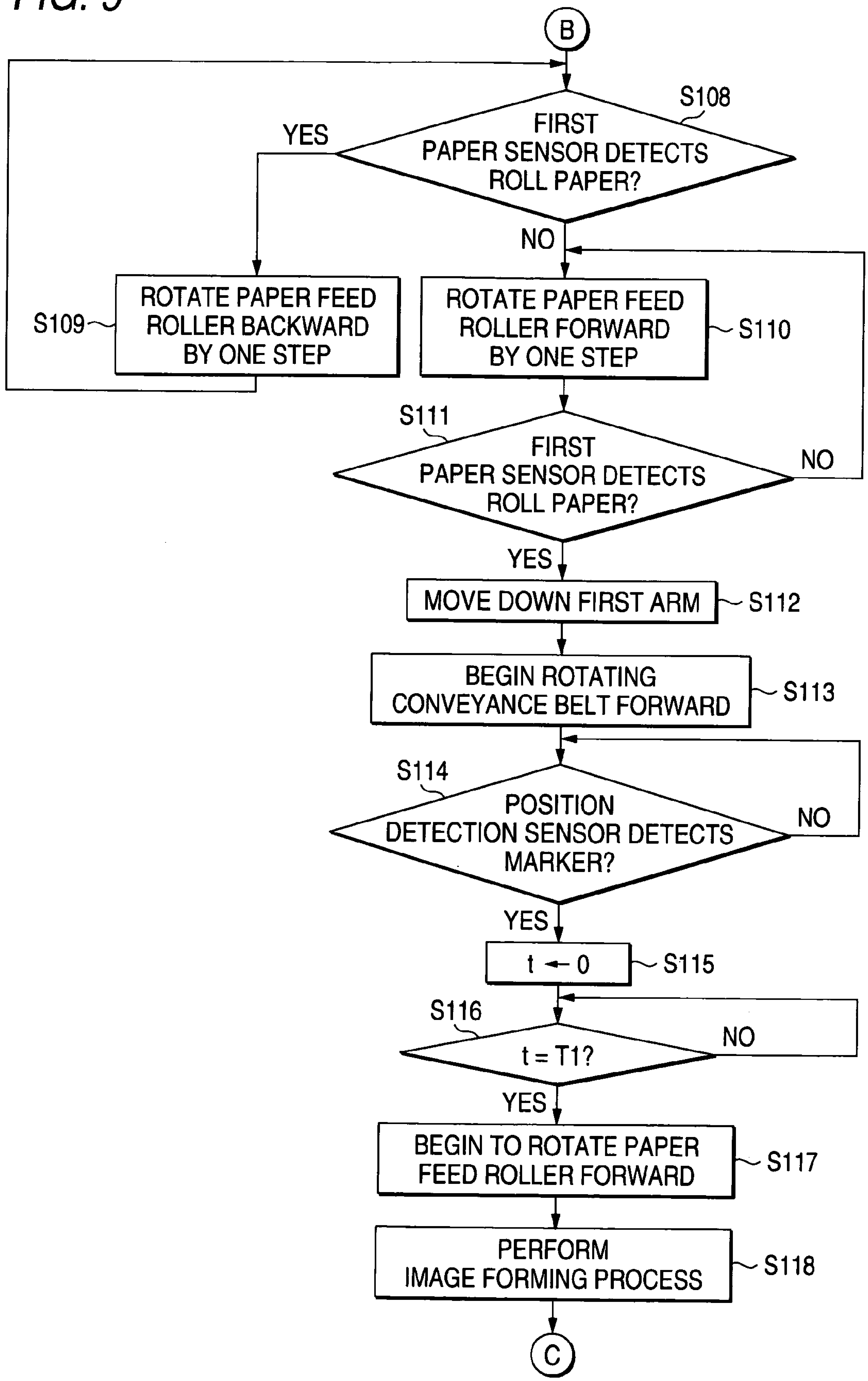

B
S108
FIRST PAPER SENSOR DETECTS ROLL PAPER?
YES
NO
ROTATE PAPER FEED ROLLER BACKWARD BY ONE STEP
S109
ROTATE PAPER FEED ROLLER FORWARD BY ONE STEP
S110
S111
FIRST PAPER SENSOR DETECTS ROLL PAPER?
NO
YES
MOVE DOWN FIRST ARM
S112
BEGIN ROTATING CONVEYANCE BELT FORWARD
S113
S114
POSITION DETECTION SENSOR DETECTS MARKER?
NO
YES
t ← 0
S115
S116
t = T1?
NO
YES
BEGIN TO ROTATE PAPER FEED ROLLER FORWARD
S117
PERFORM IMAGE FORMING PROCESS
S118
C

FIG. 10

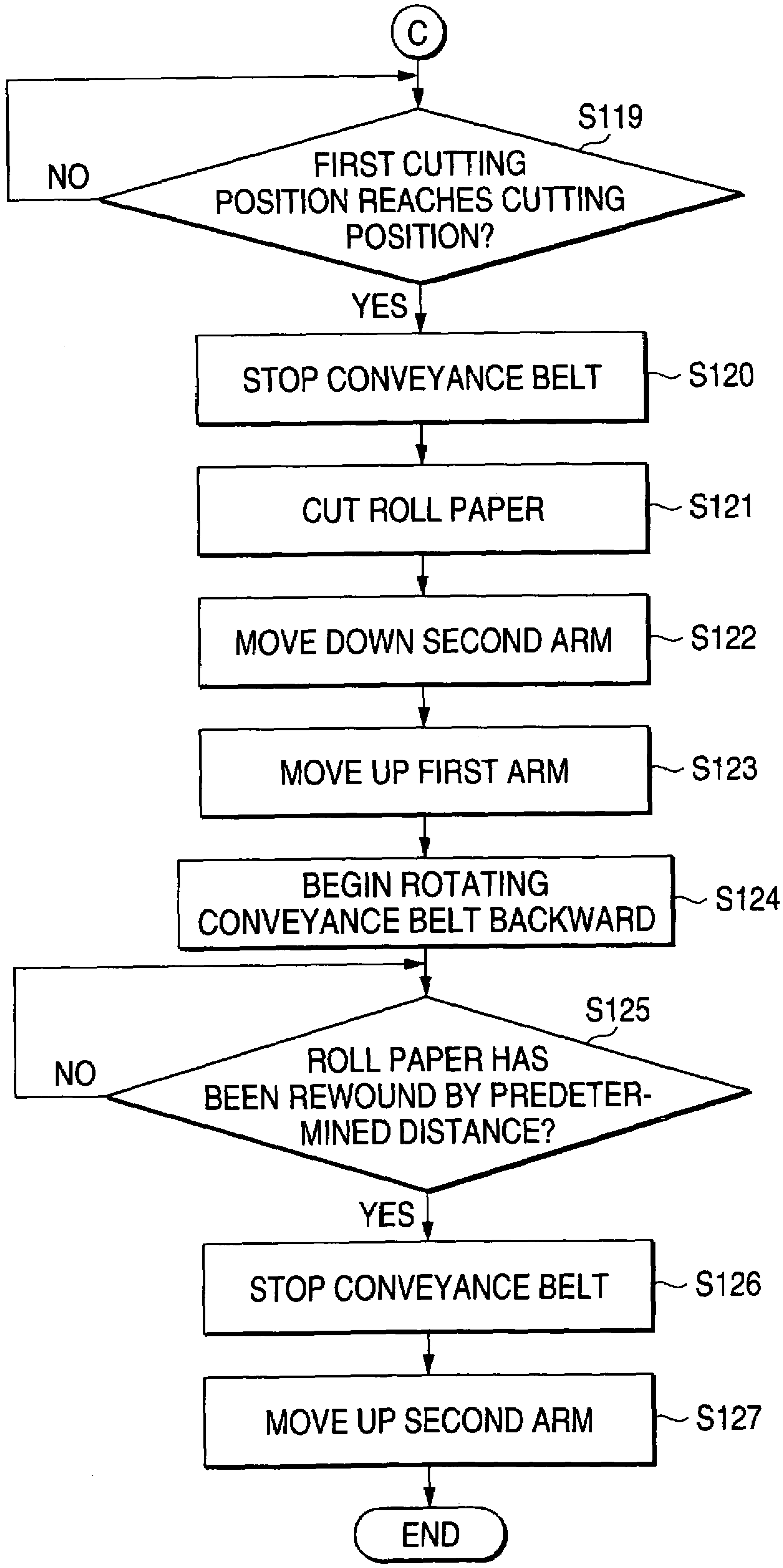

C
S119
FIRST CUTTING POSITION REACHES CUTTING POSITION?
NO
YES
STOP CONVEYANCE BELT
S120
CUT ROLL PAPER
S121
MOVE DOWN SECOND ARM
S122
MOVE UP FIRST ARM
S123
BEGIN ROTATING CONVEYANCE BELT BACKWARD
S124
S125
ROLL PAPER HAS BEEN REWOUND BY PREDETER-MINED DISTANCE?
NO
YES
STOP CONVEYANCE BELT
S126
MOVE UP SECOND ARM
S127
END

FIG. 11A

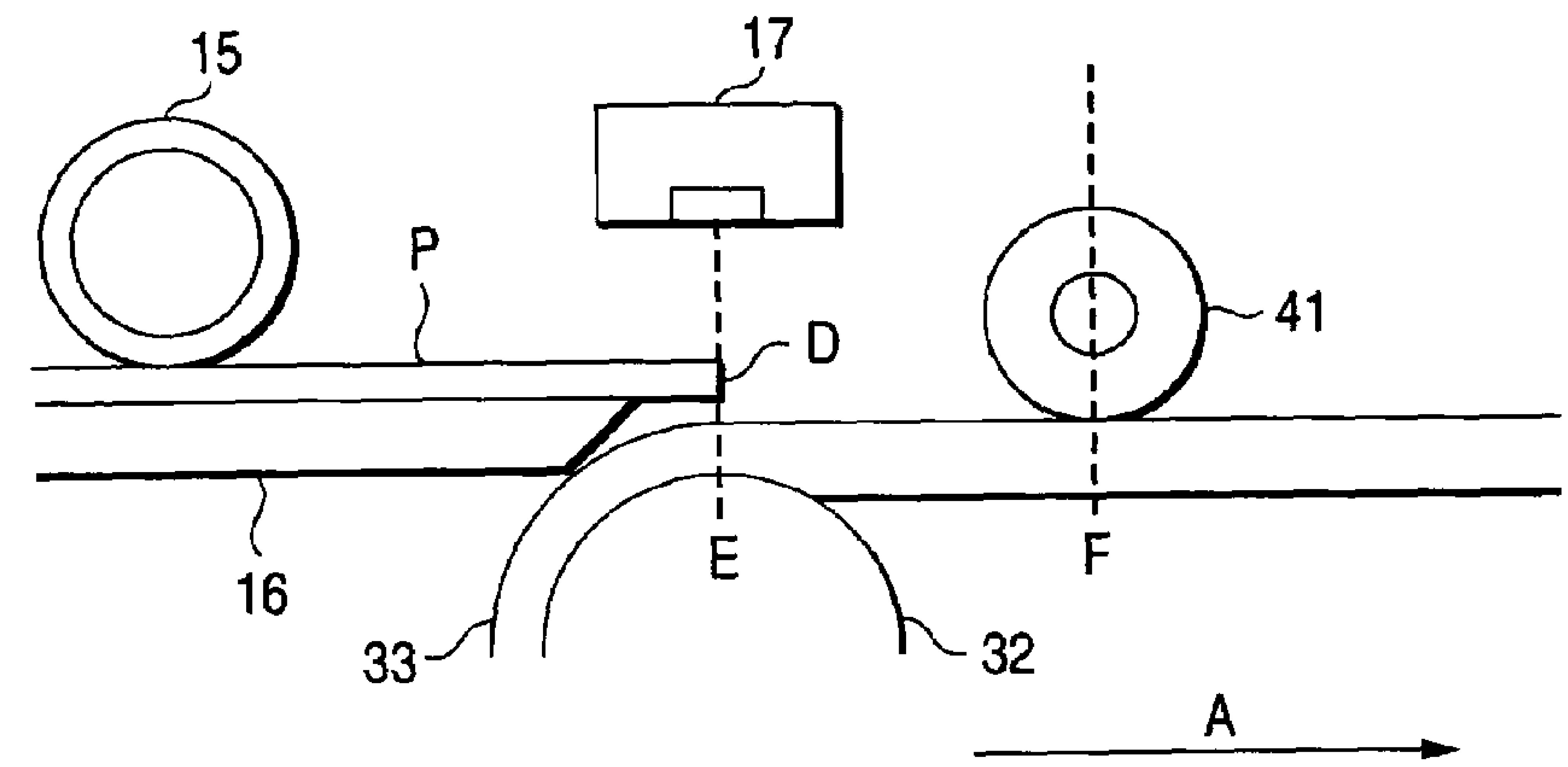


FIG. 11B

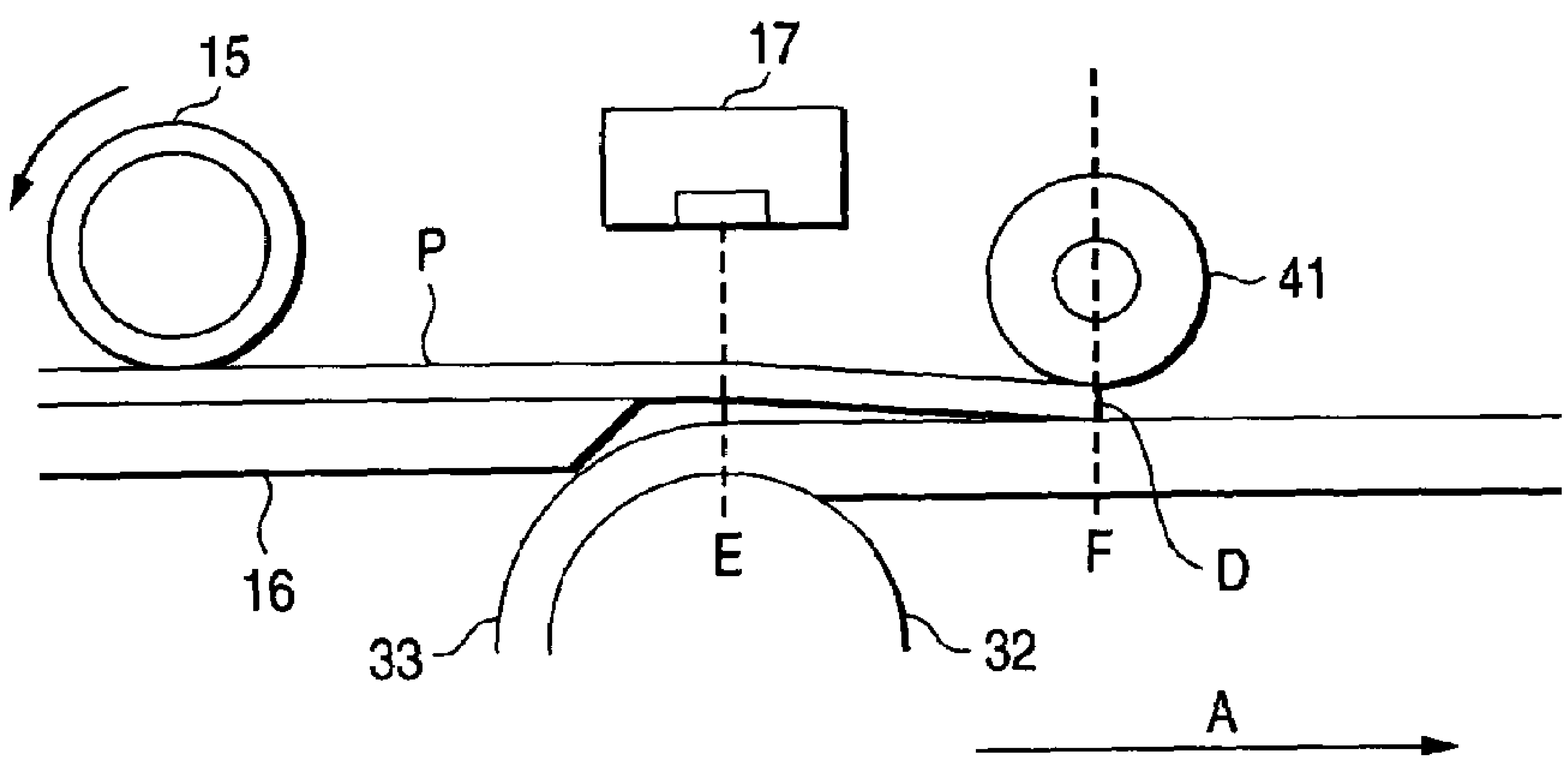
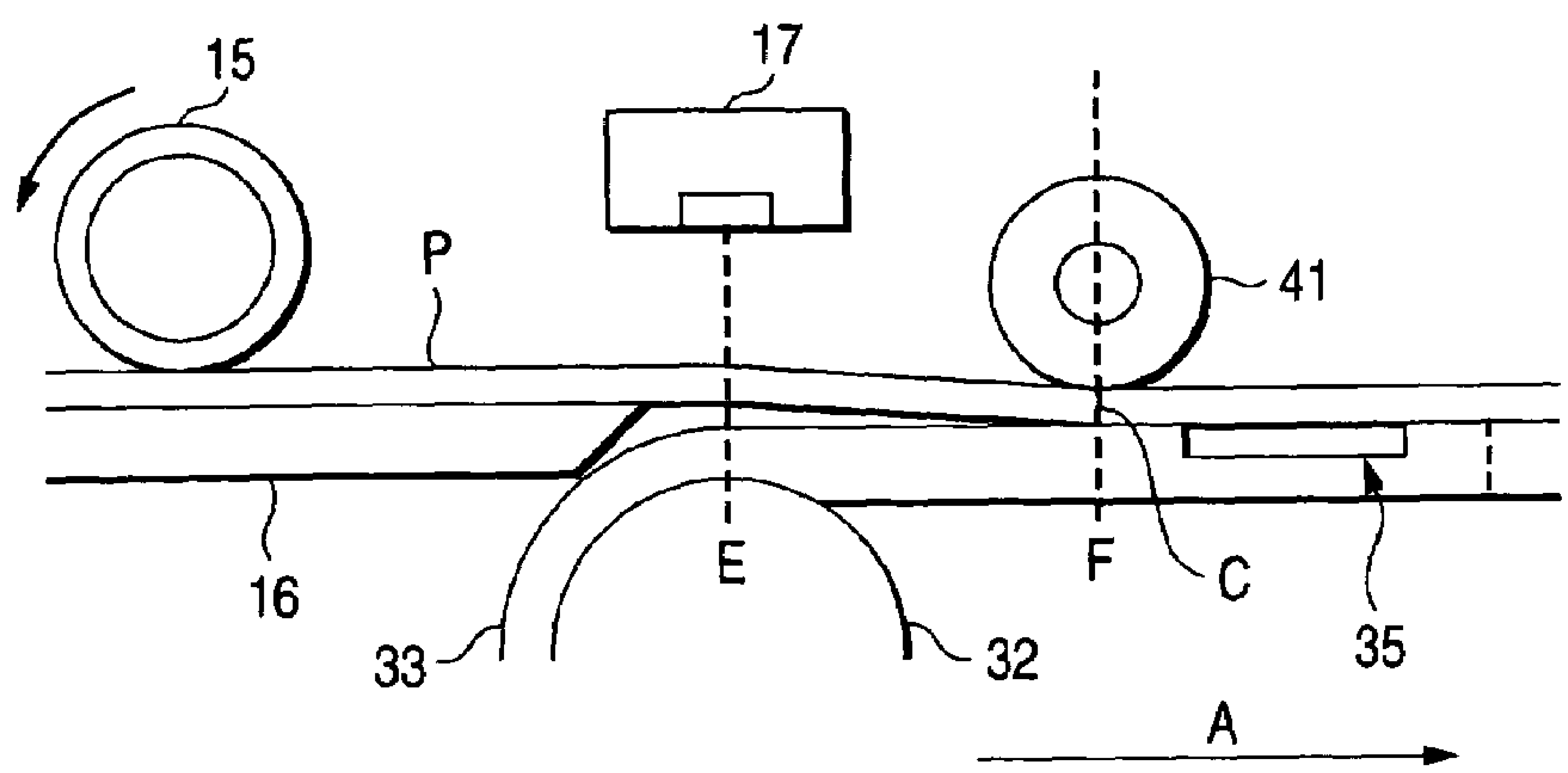


FIG. 11C



INKJET PRINTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an inkjet printer for ejecting ink onto a printing medium to thereby form an image.

2. Description of the Related Art

According to a related art, in an inkjet printer of an inkjet type for ejecting very small ink droplets from ejection holes of an inkjet head onto a recording medium so as to form a desired image, a satisfactory image can be obtained when ink ejection from the vary small ejection holes is kept good. It is therefore necessary to prevent thickened ink droplets or foreign matters from adhering to the ejection holes. To this end, in the related art, an operation of so-called flushing is performed independently of an operation of image formation. That is, ink is ejected from the ejection holes so as to remove thickened ink droplets or foreign matters.

In a serial type inkjet printer, the flushing operation can be performed in a region other than a printing medium conveyance portion because an inkjet head is movable in the width direction of a printing medium. However, in a fixed line head type inkjet printer using a conveyance belt for conveying a printing medium, ink is ejected onto the conveyance belt at the time of flushing because a recording head is fixed with respect to a printing medium conveyance portion. Accordingly, in the fixed line head type inkjet printer in the related art, an ink reception region such as a groove or an opening portion is provided in the conveyance belt. Ink is ejected only to the ink reception region at the time of flushing. Thus, the ink is prevented from adhering to the conveyance surface carrying the printing medium thereon (for example, see JP-A-2001-2873771 (pages 4 to 5; and FIG. **3**)).

Inkjet printers generally use cut paper as printing media. In recent years, inkjet printers are used for various expanded applications. There is an increasing demand for recording not only on the cut paper but also on a long printing medium rolled up, such as roll paper.

In a typical inkjet printer using roll paper, the roll paper is set upstream in the printing medium feed direction, while the front end of the roll paper is set at the entrance of the conveyance path. Image recording is performed with the roll paper being carried and conveyed on a conveyance belt by a pinch roller (e.g. JP-A-Hei. 10-139239 (pages 4 to 5; and FIG. **1**)).

SUMMARY OF THE INVENTION

In the configuration where an image is formed on roll paper in the inkjet printer having an ink reception region in the conveyance belt as described above, however, the to-be-rewound-side front end of the roll paper may be located in the ink reception region of the conveyance belt when the roll paper is cut in a predetermined position by a cutting mechanism after image formation, and the remaining paper is rewound. In this event, there is a fear that ink adhering to the ink reception region adheres to the roll paper.

It is therefore an object of the invention to solve the foregoing problems. The invention provides an inkjet printer in which the front end of a printing medium is prevented from falling into an ink reception region of a conveyance belt to thereby contaminate the printing medium with ink when the printing medium is rewound.

According to one embodiment of the invention, an ink-jet printer includes an inkjet head, a conveyance belt, a conveyance mechanism, a cutting mechanism, a control unit, and a judgment unit. The inkjet head ejects ink onto a printing medium to form an image thereon. The conveyance belt defines on an outer circumferential surface thereof a groove extending in a direction intersecting with a conveyance direction. The conveyance mechanism drives the conveyance belt to travel in the conveyance direction and in a direction opposite to the conveyance direction. The cutting mechanism is disposed downstream in the conveyance direction with respect to the conveyance belt and cuts the printing medium. The control unit controls at least the conveyance mechanism and the cutting mechanism. The judgment unit, after the cutting mechanism cuts the printing medium, judges whether or not a cut position of the printing medium will be located in a predetermined region of the conveyance belt if the conveyance mechanism drives the conveyance belt to convey the printing medium in the direction opposite to the conveyance direction. The predetermined region of the conveyance belt includes the groove. When the judgment unit judges that the cut position of the printing medium will be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing mechanism on the conveyance belt in the conveyance direction and subsequently controls the cutting mechanism to cut the printing medium. When the judgment unit judge that the cut position of the printing medium will not be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing medium on the conveyance belt in the direction opposite to the conveyance direction.

According to one embodiment of the invention, an ink-jet printer includes an inkjet head, a feeding mechanism, a conveyance belt, a conveyance mechanism, a cutting mechanism, a control unit, a determination unit, and a calculation unit. The inkjet head ejects ink onto a printing medium to form an image thereon. The feeding mechanism feeds the printing medium in a conveyance direction. The conveyance belt defines on an outer circumferential surface thereof a groove extending in a direction intersecting with the conveyance direction. The conveyance mechanism drives the conveyance belt to travel in the conveyance direction and in a direction opposite to the conveyance direction. The cutting mechanism is disposed downstream in the conveyance direction with respect to the conveyance belt and cuts the printing medium. The control unit controls at least the feeding mechanism, the conveyance mechanism, and the cutting mechanism. The determination unit determines a to-be-cut position of the printing medium based on image data. The calculation unit calculates a timing at which if the feeding mechanism begins feeding the printing medium in the conveyance direction, the to-be-cut position of the printing medium will be located on the conveyance belt except for a predetermined region including the groove. The control unit controls the feeding mechanism to begin feeding the printing medium at the timing calculated by the calculation unit. The control unit controls the conveyance mechanism and the cutting mechanism so that the cutting mechanism cuts the printing medium at the to-be-cut position thereof. After the cutting mechanism cuts the printing medium at the to-be-cut position thereof, the control unit controls the conveyance mechanism to convey the printing medium on the conveyance belt in the direction opposite to the conveyance direction.

According to the embodiments and examples of the invention, an inkjet printer ejects ink onto a printing medium stored in a rolled state to form an image and includes an ink reception groove to which ink will be ejected at the time of flushing in the conveyance belt. When the printing medium on which an image has been formed is cut and the storage portion-side printing medium is rewound, the front end of the printing medium is prevented from falling into the ink reception groove of the conveyance belt to thereby contaminate the printing medium with ink. Also, the printing medium is suitably prevented from separating from the conveyance belt to thereby touch an ink-jet head so as to be contaminated or to cause a failure in printing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a side view showing the total configuration of an inkjet printer according to an embodiment of the invention. FIG. **1**B shows a state where a marker **36** is located at a detection position G and a detection sensor **37** detects the marker **36**. FIG. **1**C shows a state where a conveyance motor **77** rotates N**1** times after the state shown in FIG. **1**B. FIG. **1**D shows a state where the conveyance motor **77** rotates N**2** times after the state shown in FIG. **1**B.

FIG. **2** is a perspective view showing the schematic configuration of a conveyance system.

FIG. **3** is a schematic block diagram showing the configuration of a control system of the inkjet printer.

FIG. **4** is an operation flow chart showing the outline of a printing operation in Embodiment 1.

FIG. **5** is an operation flow chart showing the outline of the printing operation in Embodiment 1.

FIG. **6** is a view showing the state of roll paper P in which an image has been formed.

FIGS. **7**A to **7**C are explanatory views showing the circumstances of the periphery of a first cutting position observed from the width direction of a conveyance belt.

FIG. **8** is an operation flow chart showing the outline of a printing operation in Embodiment 2.

FIG. **9** is an operation flow chart showing the outline of the printing operation in Embodiment 2.

FIG. **10** is an operation flow chart showing the outline of the printing operation in Embodiment 2.

FIGS. **11**A to **11**C are views showing the state of the vicinity of a paper feed portion observed from the width direction of a conveyance belt.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention will be described below.

An inkjet printer according to a first embodiment includes an inkjet head, a conveyance belt defining an ink reception groove on an outer circumferential surface thereof, a conveyance mechanism that drives the conveyance belt, a cutting mechanism that cuts the printing medium, a control unit, and a judgment unit.

In the inkjet printer according to the first embodiment configured thus, the printing medium is conveyed in the conveyance direction. The inkjet head ejects ink onto the printing medium to form an image thereon. Then, the control unit controls the cutting mechanism to cut the printing medium at a to-be-cut position, which is determined on the basis of the length of the image in order to extract, from the ink-jet printer, the portion of the printing medium where the image has been formed. The judgment unit judges whether or not the front end of the printing medium will be located in a predetermined region including the ink reception groove of the conveyance belt if the printing medium is rewound. It is judged, based on the judgment result of the judgment unit, that the cut position of the printing medium will be located in the predetermined region, the control unit controls the conveyance mechanism further conveys to convey the printing mechanism on the conveyance belt in the conveyance direction and then controls the cutting mechanism to cuts the printing medium again. When the judgment unit concludes that the cut position of the printing medium will not be located in the predetermined region of the conveyance belt, the control unit controls the conveyance mechanism to rewind the printing medium.

Due to the aforementioned configuration, in the ink-jet printer according to the first embodiment, there is no fear that, at the time of rewinding the printing medium, the front end of the printing medium is located in the ink reception groove so that the printing medium is contaminated with ink adhering to the ink reception groove.

An inkjet printer according to a second embodiment includes an inkjet head, a feeding mechanism that feeds the printing medium in a conveyance direction, a conveyance belt that defines on an outer circumferential surface thereof an ink reception groove, a conveyance mechanism that drives the conveyance belt, a cutting mechanism that cuts the printing medium, a control unit, a determination unit, and a calculation unit.

In the inkjet printer according to the second embodiment configured thus, at first the determination unit determines a to-be-cut position of the printing medium based on image data. It is preferable that the to-be-cut position is located upstream in the conveyance direction with respect to a region where an image will be formed. Then, the calculation unit calculates a timing at which if the feeding mechanism begins feeding the printing medium in the conveyance direction, the to-be-cut position of the printing medium will be located on the conveyance belt except for a predetermined region including the ink reception groove. The control unit controls the feeding mechanism to begin feeding the printing medium at the timing calculated by the calculation unit. After that, the conveyance belt conveys the printing medium fed from the feeding mechanism, and the inkjet head ejects ink onto the printing medium to form the image. The control unit controls the cutting mechanism to cut the printing medium at the to-be-cut position thereof. The control unit controls the conveyance mechanism to rewind the printing medium.

In the inkjet printer according to the second embodiment configured thus, the front end of the storage portion-side medium is prevented from being located in the ink reception groove when the storage portion-side medium is rewound. Thus, there is no fear that the printing medium is contaminated with ink adhering to the ink reception groove.

EXAMPLE 1

A preferred example of the invention will be described below with reference to the drawings. FIG. **1**A is a side view showing the total configuration of an inkjet printer **10** according to this example.

The inkjet printer **10** shown in FIG. **1**A is a line-printing-type color inkjet printer having four long inkjet heads **12**. In a printer body **11** serving as a housing of the inkjet printer **10**, a paper feed portion **14** (serving as a medium feed mechanism) having a paper feed roller **15** is provided on the left of FIG. **1**A, and a discharge portion **19** is provided on the right of FIG. **1**A, while a conveyance unit **30** (serving as a conveyance mechanism) having a conveyance belt **33** is provided in the central portion of FIG. **1**A. Roll paper P as along printing medium stored like a roll in a roll paper cassette **20** (serving as a storage portion) is conveyed to pass under the inkjet heads **12** for forming an image thereon. Incidentally, the direction running from the roll paper cassette **20** toward the inkjet heads **12** will be referred to as a medium feed direction (an arrow A direction in FIG. **1**A).

(Image Forming Mechanism) The inkjet heads **12** have head bodies **13** in their lower ends, respectively. Each head body **13** has a flow path unit and an actuator unit pasted together. Ink flow paths including pressure chambers are formed in the flow path unit, and the actuator unit is to apply pressure to ink in each pressure chamber. In addition, the head bodies **13** have rectangular sections, respectively, and are disposed closely to each other so that their longitudinal directions are perpendicular to the medium feed direction of the paper (perpendicular to the paper of FIG. **1**A). The bottom surfaces (ejection surfaces **13***a*) of the head bodies **13** are opposed to the paper conveyance path. A large number of ejection holes having very small diameters corresponding to nozzles respectively are provided in the ejection surfaces **13***a*. Inks of magenta (M), yellow (Y), cyan (C) and black (K) are ejected from the four head bodies **13**, respectively.

The head body **13** is disposed to form a slight gap between the bottom thereof and the conveyance belt **33**. The paper conveyance path is formed in this gap. With this configuration, the inks of the respective colors are ejected from the ink ejection holes onto the upper surface (printing surface) of the roll paper P when the roll paper P carried on the conveyance belt **33** passes just under the four head bodies **13** in turn. Thus, a desired color image is formed on the paper.

(Configuration of Roll Paper Cassette) Next, description will be made on the configuration of the roll paper cassette **20**, which stores the roll paper P serving as a printing medium to be used in the inkjet printer **10**.

As shown in FIG. **1**A, the roll paper cassette **20** is detachably disposed at a position opposed to the paper feed portion **14** and on the upstream side of the printer body **11** in the medium feed direction. The roll paper cassette **20** is constituted by a lower box **21** and an upper box **22**, which can be split vertically. A feed port **23** serving as an exit for feeding the roll paper P to the paper feed portion **14** is provided in the upper box **22**. The roll paper cassette **20** is attached to the printer body **11** and fixed thereto by a not-shown fixing member so that a portion of the feed port **23** protruding outward from the roll paper cassette **20** is opposed to the paper feed portion **14**.

Two support rollers **24** are provided in the lower body **21** so as to extend in parallel to a direction (hereinafter referred to as a "printer width direction") perpendicular to the medium feed direction and perpendicular to the paper of FIG. **1**A. The support rollers **24** rotatably support paper roll Q from the inside of its roll-like shape. The paper roll Q designates the roll paper P wound like a roll. The support rollers **24** are inserted into a hollow portion of the paper roll Q and supported rotatably and removably at both ends of the lower box **21** in the printer width direction.

The upper box **22** includes the feed port **23**, an urging roller **25**, a spring **26** for supporting the urging roller **25** rotatably and elastically, and a guide roller **27** for rotating the roll paper P so as to guide it to the feed port **23**. The guide roller **27** is rotatably supported at its both ends by the upper box **22** on the upstream side of the feed port **23** in the medium feed direction.

The urging roller **25** supported on the spring **26** has an operation of absorbing an impact acting on the roll paper P at the beginning of rotation of the paper roll Q for starting to convey the roll paper P. When a printing operation is initiated to drive the paper feed roller **15** (to rotate the paper feed roller **15** in a direction to convey the roll paper P in the medium feed direction), the paper roll Q begins to rotate. In this event, large impact is instantaneously applied to the roll paper P due to the inertial force on the rotation of the paper roll Q. In this event, there is a fear that the paper roll Q may rattle unstably, or that a paper feed motor **79** (see FIG. **4**) giving a driving force to the paper feed roller **15** may be locked due to a sudden change in tension acting on the roll paper P. The paper feed motor **79** will be described later. In addition, there is a fear that printing misalignment may occur due to an instantaneous stop of the conveyance of the roll paper P caused by the impact, or that the roll paper P in close contact with the conveyance belt **33** maybe separated from the conveyance belt **33**. However, the urging roller **25** moves while rotating and giving moderate tension to the roll paper P due to the spring **26**, so that the urging roller **25** can absorb the impact generated in the roll paper P.

(Medium Feed Mechanism) Next, description will be made on the configuration of the conveyance system of the inkjet printer **10** with reference to FIGS. **1**A and **2**. FIG. **2** is a perspective view showing the schematic configuration of the conveyance system.

As shown in FIG. **1**A, the paper feed portion **14** for feeding the roll paper P taken out from the roll paper cassette **20** to the conveyance unit **30** which will be described later is constituted by a paper feed roller **15**, a paper feed base **16** and a guide wall (not shown). The roll paper P is pressed and held between the paper feed base **16** and the paper feed roller **15**. The guide wall is provided in parallel to the medium feed direction. Aside end of the roll paper P is made to abut against the guide wall so as to prevent the roll paper P from slanting. The paper feed roller **15** is rotatably supported at its both ends, and connected at its one end to a paper feed motor **79** (see FIG. **3**). The paper feed roller **15** presses and holds the roll paper P on the top of the paper feed base **16**, and feeds the roll paper P in the medium feed direction by means of driving of the paper feed motor **79**. In addition, the paper feed roller **15** is disposed so that its rotation axis tilts at an angle of three degrees with respect to the medium feed direction. Accordingly, when the paper feed roller **15** is driven to convey the roll paper P, the roll paper P is fed toward the conveyance unit **30**, and forcibly made to approach the not-shown guide wall before a paper front end D (see FIG. **6**), which is the downstream end of the roll paper P in the medium feed direction, reaches the conveyance unit **30**. Thus, a width-direction end portion of the roll paper P abuts against the guide wall so that the roll paper P is aligned in parallel to the medium feed direction. Incidentally, when the paper feed motor **79** rotates forward, the paper feed roller **15** rotates in a direction to feed the roll paper P downstream in the medium feed direction. On the contrary, when the paper feed motor **79** rotates backward, the paper feed roller **15** rotates in a direction to rewind the roll paper P upstream in the medium feed direction. The paper feed motor **79** is a stepping motor, which rotates forward by one step in response to a pulse of a positive voltage signal applied thereto, and rotates backward by one step in response to a pulse of a negative voltage signal applied thereto.

(Paper Sensor) First and second paper sensors **17** and **18**, which are photo-sensors for detecting the paper front end D of the roll paper P on the downstream side in the medium feed direction, are provided in the inkjet printer **10** as shown in FIG. **1**A. The first paper sensor **17** is provided between the paper feed roller **15** and the position where the conveyance belt **33** is disposed. The second paper sensor **18** is disposed on the upstream side of the inkjet heads **12** in the medium feed direction. Each paper sensor is disposed to be opposed to the conveyance belt **33**.

The first paper sensor **17** is used for stopping the paper front end D of the roll paper P in an initial position E (in this example, a position where the paper front end D is opposed to the first paper sensor **17**, see FIG. **1**A) set between the conveyance unit **30** and the first close contact mechanism **40** when the roll paper P is fed out to the conveyance belt **33**. In the inkjet printer **10** according to this example, ink reception grooves **35** for receiving ink at the time of flushing are provided in the conveyance belt **33**. Accordingly, when the roll paper P is fed out by the paper feed roller **15**, there is a fear that the paper front end D may be located in one of the ink reception grooves **35**. Therefore, the paper front end D is stopped in the initial position E by the first paper sensor **17**, and the paper feed roller **15** is rotated at the timing with which the paper front end D will not be located in any ink reception groove **35** as will be described later. Thus, the paper front end D can be prevented from being located in any ink reception groove **35**, so that the ink adhering to the inside of the ink reception groove **35** can be prevented from being transferred to the roll paper P.

The second paper sensor **18** is used for determining the start timing of image formation by the inkjet head **12**. Incidentally, each of the first and second paper sensors **17** and **18** is an optical sensor constituted by a light emitting device and a light receiving device, which detect the paper front end D by detecting the intensity of reflected light generated from a difference in reflectance between the roll paper P and the conveyance belt **33**.

(Conveyance Unit) Next, the configuration of the conveyance unit **30** will be described with reference to FIGS. **1**A and **2**.

As shown in FIG. **1**A, the conveyance unit **30** includes two belt rollers **31** and **32**, and an endless conveyance belt **33** laid between the two rollers **31** and **32**. The conveyance unit **30** is disposed under the ink ejection surfaces **13***a* of the inkjet heads **12** at a predetermined distance therefrom.

As shown in FIG. **2**, each of the two belt rollers **31** and **32** is constituted by a cylindrical body and flange portions **31***b*, **32***b*. The cylindrical body has a cylindrical shape in contact with the inner circumferential surface of the conveyance belt **33**. The flange portions **31***b*, **32***b* are provided in both end portions of the cylindrical body. Each flange portion **31***b*, **32***b* has a radius substantially as large as a radius corresponding to the total value of the thickness of the conveyance belt **33** and the radius of the cylindrical body. The belt rollers **31** and **32** are rotatably supported by not-shown rotation shafts provided in the flange portions **31***b* and **32***b*, respectively. Of the two belt rollers **31** and **32** of the conveyance unit **30**, the belt roller **31** located on the downstream side of the paper conveyance path is connected to a conveyance motor **77** (see FIG. **3**), and the rotation and driving of the conveyance motor **77** is controlled by a control portion **70**, which will be described later. On the other hand, the belt roller **32** located upstream is a driven roller rotated by the torque applied to the conveyance belt **33** by the rotation of the belt roller **31**.

When the conveyance motor **77** rotates forward, the conveyance belt **33** moves (rotates forward) in a direction to convey the roll paper P downstream in the medium feed direction. When the conveyance motor **77** rotates backward, the conveyance belt **33** moves (rotates backward) in a direction to convey the roll paper P upstream in the medium feed direction. Incidentally, the conveyance motor **77** is a stepping motor rotating forward by one step in response to a pulse of a positive voltage signal applied thereto and rotating backward by one step in response to a pulse of a negative voltage signal applied thereto.

The conveyance belt **33** is an endless loop-like belt having elasticity. The material of the conveyance belt **33** is not limited especially. For example, silicon rubber, EPDM, urethane rubber, butyl rubber or the like may be used. Treatment with adhesive silicon rubber is performed on a surface (hereinafter referred to as "conveyance surface") **34** of the conveyance belt **33**, which will be brought into contact with the roll paper P. Accordingly, the conveyance unit **30** can convey the roll paper P carried thereon, in the medium feed direction and in an opposite direction thereto by the rotation and driving of one belt roller **31** of the conveyance unit **30** while holding the roll paper P on the conveyance surface **34** of the conveyance belt **33** due to its adhesive force. The roll paper P, which has been wound and stored like a roll in the roll paper cassette **20**, has a tendency of curling. However, since the roll paper P is conveyed on the conveyance surface **34** while being held thereon due to the adhesive force, the roll paper P is prevented from being separated therefrom due to the tendency of curling. Therefore, when the roll paper P is conveyed, the roll paper P is prevented from touching the ejection surfaces **13***a* of the inkjet heads **12** and allowing ink to adhere to the roll paper P.

Independently of the operation of image formation, the inkjet printer **10** performs an operation of flushing for ejecting ink from the ejection holes onto the conveyance belt **33** so as to remove thickened ink droplets or foreign matters from the head body **13**. To this end, the ink reception grooves **35** for receiving the ink in the flushing operation are provided in two places of the outer circumferential surface of the conveyance belt **33**. The ink reception grooves **35** extend all over the width of the conveyance belt **33** and in parallel with a direction (printer width direction) crossing the medium feed direction. Incidentally, the two ink reception grooves **35** are provided at an equal interval on the conveyance belt **33**.

A marker **36** (serving as a member to be detected) having a light reflectance different from that of the conveyance surface is provided in the conveyance surface **34** of the conveyance belt **33** and at a predetermined distance from each ink reception groove **35**. Incidentally, in this example, the position where the marker **36** is disposed is regarded as an origin on the conveyance belt **33** set at a predetermined position with respect to the ink reception groove **35**. In addition, in order to detect the marker **36**, an origin detection sensor **37** (see FIG. **1**A) is provided under the conveyance belt **33** and at a position close to the belt roller **32** so as to be opposed to the outer circumferential surface of the conveyance belt **33**. The origin detection sensor **37** is a photo-sensor for detecting the marker **36** (origin) based on a change in intensity of reflected light due to the marker **36**.

In addition, in a region surrounded by the conveyance belt **33**, a guide member **38** having a substantially rectangular parallelepiped shape is disposed in contact with the inner circumferential surface of the conveyance belt **33** on its top side so as to support the conveyance belt **33**. The guide member **38** is formed to have a width substantially equal to that of the conveyance belt **33**.

(Release Mechanism) As shown in FIG. **1**A, a release plate **39** is provided on the downstream side of the conveyance belt **33** in the medium feed direction. The release plate **39** is designed to release the roll paper P adhering to the conveyance surface **34** of the conveyance belt **33**, from the conveyance surface **34**. (First Close Contact Mechanism) Next, description will be made on the first close contact mechanism **40** for bringing the roll paper P fed out from the paper feed portion **14**, into close contact with the conveyance surface **34** of the conveyance belt **33**. The first close contact mechanism **40** is constituted by a first pressure roller **41**, a first arm **42**, a cam **43** and a spring **44**.

In the first close contact mechanism **40**, the cam **43** is driven by a first drive motor **83** (see FIG. **3**) so that the cam **43** comes into contact with the lower surface of the first arm **42** and lifts up the first arm **42**. When the cam **43** keeps rotating further in this state, the cam **43** leaves the first arm **42** so that the first arm **42** is urged downward by the spring **44** and the first pressure roller **41** presses the roll paper P onto the conveyance belt **33**. In such a manner, the first close contact mechanism **40** can bring the roll paper P into close contact with the conveyance belt **33**.

(Second Close Contact Mechanism) Next, description will be made on the second close contact mechanism **50** for bringing the roll paper P released by the release plate **39**, into close contact with the conveyance surface **34** of the conveyance belt **33** again in the rewinding operation for conveying the roll paper P in the opposite direction to the medium feed direction. The second close contact mechanism **50** is constituted by a second pressure roller **51**, a second arm **52**, a cam **53** and a spring **54**.

In the second close contact mechanism **50**, the cam **53** is driven by a second drive motor **85** (see FIG. **3**) so that the cam **53** comes into contact with the lower surface of the second arm **52** and lifts up the second arm **52**. When the cam **53** keeps rotating further in this state, the cam **53** leaves the second arm **52** so that the second arm **52** is urged downward by the spring **54** and the second pressure roller **51** presses the roll paper P onto the conveyance belt **33**. In such a manner, the second close contact mechanism **50** can bring the roll paper pin to close contact with the conveyance belt **33** again in the rewinding operation. (Cutting Mechanism) Next, description will be made on the cutting mechanism **60** for cutting the roll paper P upstream in the medium feed direction with respect to the region where an image is formed after the inkjet head **12** forms the image and the roll paper P having the image formed thereon is fed out to the discharge portion **19**.

As shown in FIG. **1**A, the cutting mechanism **60** is constituted by a movable blade **61**, a fixed blade **62**, and an actuator **63** moving up and down while supporting the movable blade **61**. The movable blade **61** is a blade-like member whose lower end portion is wider than the roll paper P and which has a blade surface inclined with respect to the horizontal direction. The movable blade **61** is fixed to the actuator **63** so that the blade surface looks downward. On the other hand, the fixed blade **62** has the same width as the movable blade **61**, and the blade surface of the fixed blade **62** is formed horizontally. The fixed blade **62** is fixed in the opening portion formed in the conveyance path under the movable blade **61** so that the blade surface of the fixed blade **62** does not project on the conveyance path. In such a configuration, the actuator **63** to which the movable blade **61** is fixed is driven by a cutter drive motor **81** (see FIG. **3**) so as to move up and down. Thus, the roll paper P is cut at the position where the movable blade **61** and the fixed blade **62** overlap each other. The timing of the cutting operation with the actuator **63** is controlled by the control portion **70** which will be described later. The roll paper P is cut by the cutting mechanism **60** configured thus. The roll paper P where the image has been formed can be taken out from the discharge portion **19**. Incidentally, the cutting mechanism **60** is not limited to the aforementioned configuration. For example, the cutting mechanism **60** may be a so-called rotary cutter for cutting the roll paper P while rotating. (Configuration of Control System) Next, the configuration of the control portion **70** of the inkjet printer **10** will be described with reference to FIG. **3**. FIG. **3** is a schematic block diagram showing the configuration of the control system of the ink-jet printer **10**.

The control portion **70** of the inkjet printer **10** includes a CPU **71**, which is a central processing unit, a ROM **72** for storing programs and data to be used for control by the CPU **71**, and a RAM **73**, which is a temporary storage memory.

The CPU **71**, the ROM **72** and the RAM **73** are connected to an input/output interface **74** through a data bus. In addition, a head driver **75** for driving the inkjet heads **12**, a motor driver **76** for driving the conveyance motor **77**, a motor driver **78** for driving the paper feed motor **79**, a motor driver **80** for driving the cutter drive motor **81**, a motor driver **82** for driving the first drive motor **83**, a motor driver **84** for driving the second drive motor **85**, the first paper sensor **17**, the second paper sensor **18**, the origin detection sensor **37**, and an external interface **86** for making communication for various external data such as image data, are connected to the input/output interface **74**. These various drivers and sensors can input/output signals from/to the control portion **70** through the input/output interface **74**.

(Printing Operation)

The printing operation to be executed by the inkjet printer **10** configured thus will be described with reference to FIGS. **4** to **6** and FIGS. **7**A to **7**C. FIGS. **4** and **5** are operation flow charts schematically showing the printing operation in the inkjet printer **10**. FIG. **6** is a view showing the state of the roll paper P on which an image has been formed. FIGS. **7**A to **7**C are explanatory views showing the circumstances of the periphery of a first cutting position C observed in the width direction of the conveyance belt **33** when the roll paper P is cut at the first cutting position C, and the conveyance belt **33** is then rotated backward to rewind the storage portion-side roll paper as it is, as will be described later. The first cutting position C is set as a position at which the roll paper P will be cut after the image is formed and which is located upstream in the medium feed direction with respect to the region where an image is formed on the roll paper P. When there are a plurality of images, the first cutting position C means a position where the roll paper P will be finally cut upstream in the medium feed direction with respect to the region where the last image is formed. Incidentally, it is assumed that before executing the printing operation, which will be described later, the CPU **71** in advance generates print data including data as to the timing with which ink will be ejected from each inkjet head **12**, data as to the timing with which the roll paper P will be cut at the first cutting position C, and the like on the basis of a print instruction signal received through the external interface **86**. In addition, it is assumed that the roll paper P is set beforehand at a position where the roll paper P is in contact with the paper feed roller **15**.

When the printing operation is initiated, first the CPU **71** controls the paper feed roller **15** to move the roll paper P so that the paper front end D of the roll paper P is located at the initial position E. In Step S**10** (hereinafter expressed by only "S**10**". The same thing will be applied to any other step,) shown in FIG. **4**, the CPU **71** judges whether or not the first paper sensor **17** detects the roll paper P. When the first paper sensor **17** detects the roll paper P (S**10**: YES), the paper front end D of the roll paper P is located on the conveyance belt **33** side with respect to the initial position E. Accordingly, the CPU **71** rotates the paper feed roller **15** backward by one step (rotates the paper feed motor **79** by one step. The same thing will be applied to the following cases.) (Step **11**), and makes a judgment in S**10** again as to whether or not the first paper sensor **17** detects the roll paper P. The CPU **71** repeats the processings of S**10**–S**11** till the roll paper P is not detected.

When the roll paper P is not detected in S**10** (S**10**: NO), the paper front end D of the roll paper P is located on the paper feed roller **15** side with respect to the initial position E. Accordingly, the CPU **71** rotates the paper feed roller **15** forward by one step (S**12**). After that, the CPU **71** judges whether or not the first paper sensor **17** detects the roll paper P. When the roll paper P is not detected (S**13**: NO), the paper front end D is regarded as still located on the paper feed roller **15** side with respect to the initial position E. Thus, the CPU **71** returns to the processing of S**12**. On the contrary, when the first paper sensor **17** detects the roll paper P (S**13**: YES), the paper front end D of the roll paper P is regarded as located at the initial position E. Thus, the CPU **71** advances to the processing of S**14**.

In S**14**, the CPU **71** moves down the first arm **42** so that the pressure roller **41** of the first close contact mechanism **40** is located at a position (first close contact position F, see FIG. **1**A) where the pressure roller **41** presses the conveyance belt **33**. When the first arm **42** is moved down in advance before the roll paper P is fed out by the paper feed roller **15**, the roll paper P can be brought into close contact with the conveyance belt **33** from the paper front end D of the roll paper P.

After the first arm **42** moves down, the CPU **71** gives an instruction to the conveyance motor **77** so that the conveyance belt **33** begins to rotate forward (S**15**). After that, the CPU **71** monitors a detection signal of the origin detection sensor **37** as to whether the marker **36** provided in the conveyance belt **33** has passed a position (detection position G) faces the origin detection sensor **37** or not (S**16**). FIG. **1**B shows a state where the marker **36** is located at the detection position G and the detection sensor **37** detects the marker **36**. In this example, when the marker **36** faces the origin detection sensor **37** as shown in FIG. **1**B, the ink reception groove **35** is located in a predetermined position. In this event, the CPU **71** resets the rotation step number n of the conveyance motor **77** stored in the RAM **73** to be “0”. Based on the rotation step number n of the conveyance motor **77**, the CPU **71** calculates the traveling distance of the conveyance belt **33** after the ink reception groove **35** is located at the predetermined position. Thus, the CPU **71** can determine the position where the ink reception groove **35** is located.

When the origin detection sensor **37** detects the marker **36** in S**16** (S**16**: YES), the CPU **71** rotates the paper feed motor **79** forward (S**17**). When the paper feed motor **79** begins to rotate forward (begins paper feeding), the roll paper P is fed out from the roll paper cassette **20** by the paper feed roller **15** so that the paper front end D of the roll paper P is fed onto the conveyance belt **33**. This example is designed as follows. That is, when the origin detection sensor **37** detects the marker **36**, the paper feed motor **79** is rotated forward so as to prevent the paper front end D of the roll paper P from being located in any ink reception groove **35**. However, the timing with which the paper feed motor **79** is rotated forward may be changed suitably in accordance with the convenience of the design. As soon as paper feeding is started, the CPU **71** begins monitoring the second paper sensor **18** as to whether or not the second paper sensor **18** detects the roll paper P.

The roll paper P fed out by the paper feed roller **15** reaches the first close contact position F while facing the conveyance belt **33**. When the roll paper P reaches the first close contact position F, the first pressure roller **41** presses the roll paper P onto the conveyance belt **33** to bring the paper P into close contact with the conveyance belt **33**.

When the roll paper P carried on the conveyance belt **33** is conveyed in the medium feed direction, the second paper sensor **18** detects the roll paper P (S**18**: YES), and the CPU **71** stops the paper feed roller **15** (S**19**). As soon as the roll paper P moves a predetermined distance on the conveyance belt **33** after the second paper sensor **18** detects the paper front end D of the roll paper P, the CPU **71** drives the inkjet heads **12** based on the print data so as to form an image while conveying the roll paper P (S**20**).

After the image formation process by the inkjet heads **12** is terminated, the CPU **71** monitors the first cutting position C as to whether the first cutting position C reaches a position (cutting position H, see FIG. **1**A) where the roll paper P will or not be cut by the cutting mechanism **60**, in order to discharge the image-formed region of the roll paper P to the discharge portion **19** (S**21**). As shown in FIG. **6**, the image has been formed on the roll paper P with a blank being provided over a predetermined width from the paper front end D of the roll paper P. Accordingly, the first cutting position C is a position further having a blank of a predetermined width from the region where the image has been formed. The CPU **71** calculates a distance which the first cutting position C of the roll paper P moves from a time when the image formation is terminated to a time when the first cutting position C reaches the cutting position H, based on a distance u between the paper front end D and the first cutting position C.

When the paper front end D of the roll paper P reaches the position where the release plate **39** is disposed, the roll paper P is released from the conveyance belt **33** by the release plate **39**, and fed out to the cutting position H as it is. When the first cutting position C is conveyed to the cutting position H (S**21**: YES), the conveyance belt **33** stops (S**22**), and the roll paper P is cut in the first cutting position C (S**23**).

After the roll paper P is cut at the first cutting position C, the roll paper (storage portion-side medium, which will be hereinafter referred to as “storage portion-side roll paper”) on the roll paper cassette **20** side with respect to the first cutting position C is rewound in an opposite direction to the medium feed direction by the backward rotation of the conveyance motor **77**. However, during the rewinding operation, the first cutting position C may be located in the ink reception groove **35** of the conveyance belt **33**. Therefore, before performing the rewinding operation, the CPU **71** judges whether or not the first cutting position C of the storage portion-side roll paper will be located in a predetermined region RS (see FIG. **7**A) including the ink reception groove **35** of the conveyance belt **33** during the rewinding operation (S**24**). When the first cutting position C is expected to be located in the predetermined region RS, the storage portion-side roll paper is fed downstream in the medium feed direction by a predetermined distance, and the storage portion-side roll paper is cut again. After this cutting operation (hereinafter referred to as “second cutting operation”) is performed, the rewinding operation is performed.

As shown in FIG. **7**A, when the first cutting position C is located in the ink reception groove **35** in the rewinding operation, the first cutting position C falls into the ink reception groove **35** due to its curling tendency. As a result, ink adhering to the inside of the ink reception groove **35** might be transferred to the roll paper P. Accordingly, in the ink-jet printer **10** according to this example, it is determined before the rewinding operation is started whether or not the roll paper P will be located in the predetermined region RS (the region between a border R and a border S shown in FIG. **7**A) when the rewinding operation is performed after the roll paper P is cut at the first cutting position C in S**23**. The predetermined region RS includes a region where the ink reception groove **35** is formed and a region adjacent to the ink reception groove **35** in the medium feed direction and having a predetermined width. When the first cutting position C is located in the region just adjacent to the ink reception groove **35**, the front end of the roll paper P may fall into the ink reception groove **35** due to an error in conveyance of the conveyance belt **33** or the like. When the first cutting position C is located in the downstream vicinity of the ink reception groove **35** in the medium feed direction at the time of the rewinding operation, the rewound storage portion-side roll paper may fall into the ink reception groove **35** due to its curling tendency before the storage portion-side roll paper is brought into close contact with the conveyance surface **34** of the conveyance belt **33**. Accordingly, the second cutting operation is executed when the first cutting position C is located in the predetermined region RS including the region between the region where the ink reception groove **35** is formed and the border R and the region between the region where the ink reception groove **35** is formed and the border S.

Based on the rotation step number n of the conveyance motor **77** after the origin detection sensor **37** detects the marker **36** (after the position of the ink reception groove **35** is detected) as described above, the CPU **71** judges whether or not the first cutting position C will be located in the predetermined region RS in the rewinding operation. The ROM **72** stores rotation step numbers N**1** and N**2**, which are described below, in advance. It is assumed that a distance between a virtual point X and the cutting position H is a as shown in FIGS. **1**B to **1**D. If a distance between the virtual point X and the border R is equal to a as shown in FIG. **1**C at the time when the roll paper P is cut at the first cutting position C, the first cutting position C of the roll paper P will be located at the border R in the rewinding operation as shown in FIG. **7**B. The rotation step number N**1** corresponds to a distance between the detection position G and a position of the marker **36** shown in FIG. **1**C. In other words, the rotation step number N**1** corresponds to a travel distance of the conveyance belt **33** from a timing when the origin detection sensor **37** detects the marker **36** to a timing when a to-be-cut position (which will be the first cutting position C after cutting) of the roll paper P reaches the cutting position H in a case where the to-be-cut position of the roll paper P is located on the border R during the to-be-cut position being on the conveyance belt **33**. If the origin detection sensor **37** detects the marker **36** as shown in FIG. **1**B and then the conveyance motor **77** rotates N**1** times, the ink reception groove **35** is moved from the position shown in FIG. **1**B to the position shown in FIG. **1**C.

If a distance between the virtual point X and the border S is equal to α as shown in FIG. **1**D in a case where the roll paper P is cut at the first cutting position C, the first cutting position C of the roll paper P will be located at the border S in the rewinding operation as shown in FIG. **7**C. The rotation step number N**2** corresponds to a distance between the detection position G and a position of the marker shown in FIG. **1**D. In other words, the rotation step number N**2** corresponds to a travel distance of the conveyance belt **33** from the timing when the origin detection sensor **37** detects the marker **36** to the timing when the to-be-cut position of the roll paper P reaches the cutting position H in a case where the to-be-cut position of the roll paper P is located on the border S during the to-be-cut position being on the conveyance belt **33**. If the origin detection sensor **37** detects the marker **36** as shown in FIG. **1**B and then the conveyance motor **77** rotates N**2** times, the ink reception groove **35** is moved from the position shown in FIG. **1**B to the position shown in FIG. **1**D.

In FIGS. **1**B to **1**D, the virtual point X is set above the belt roller **33**. However, it should be understood that the virtual point X may be set at a desirable position on the conveyance path of the roll paper P.

The CPU **71** compares the rotation step number n of the conveyance motor **77** after the origin detection sensor **37** detects the marker **36** (after the position of the ink reception groove **35** is detected) with the rotation step numbers N**1** and N**2** of the conveyance motor **77**, and judges whether or not the rotation step number n is in a range of the rotation step number N**2** to the rotation step number N**1**. When the rotation step number n is in a range of the rotation step number N**2** to the rotation step number N**1** (S**24**: YES), the first cutting position C will be located in the predetermined region RS. In this event, the CPU **71** makes the conveyance unit **30** convey the storage portion-side roll paper further downstream in the medium conveyance direction so as to perform the second cutting operation (S**25**), and makes the cutting mechanism **60** cut the storage portion-side roll paper again (S**26**).

The distance by which the storage portion-side roll paper is conveyed in S**25** is a distance corresponding to a case where the conveyance motor **77** is rotated forwardly by the value (N**1**−n) obtained by subtracting the value n from the rotation step number N**1**. As shown in FIG. **7**A, when the distance between the first cutting position C and the border R of the conveyance belt **33** is h, the distance h corresponds to the traveling distance of the conveyance belt **33** when the conveyance motor **77** is driven by the value obtained by subtracting the value n from the rotation number step N**1**. Accordingly, after the conveyance motor **77** is rotated forward by the rotation step number (N**1**−n), the storage portion-side roll paper is cut again, and the rewinding operation is performed. In this event, in the state shown in FIG. **7**B, the downstream front end of the storage portion-side roll paper in the medium feed direction is located at a position facing the border R of the conveyance belt **33**.

Incidentally, when the first cutting position C is not located in the predetermined region RS at the time of rewinding (S**24**: NO), it is not necessary to perform the second cutting operation. Thus, the CPU **71** jumps from the processing of S**24** to the processing of S**27**.

When the storage portion-side roll paper is rewound after the operation of cutting the roll paper P is terminated, the CPU **71** moves down the second arm **52** so as to allow the second pressure roller **51** to press the roll paper P onto the conveyance belt **33** (S**27**). Thus, the downstream portion of the storage portion-side roll paper in the medium feed direction, which has been released from the conveyance belt **33**, is brought into close contact with the conveyance belt **33** again.

Next, the CPU **71** moves up the first arm **42** so that the first pressure roller **41** leaves the conveyance belt **33** (S**28**) Incidentally, when the storage portion-side roll paper is rewound with the first pressure roller **41** pressing the storage portion-side roll paper, flexure may occur on the downstream side of the first pressure roller **41** in the medium feed direction due to the friction between the storage portion-side roll paper and the first pressure roller **41**. In this case, the flexed portion may touch the inkjet heads **12** so that the storage portion-side roll paper is contaminated with ink.

When the first pressure roller **41** leaves the conveyance belt **33**, the CPU **71** begins rotating the conveyance motor **77** backward so as to rotate the conveyance belt **33** backward (S**29**) In this event, as described previously, the storage portion-side roll paper released from the conveyance belt **33** is brought into close contact with the conveyance belt **33** again by the second pressure roller **51**.

When the conveyance belt **33** begins rotating backward, the CPU **71** monitors the second paper sensor **18** as to whether or not the second paper sensor **18** detects the front end of the storage portion-side roll paper (S**30**). When the second paper sensor **18** detects the downstream front end of the storage portion-side roll paper (S**31**: YES), the storage portion-side roll paper is rewound to a position (between the first paper sensor **17** and the conveyance belt **33**) where the downstream front end of the storage portion-side roll paper will be released from the conveyance belt **33**, and the conveyance belt **33** is stopped (S**31**). After the conveyance belt **33** is stopped, the CPU **71** moves up the second arm **52** (S**32**), and terminates the printing operation.

With the aforementioned procedure, in the inkjet printer **10** according to this example, there is no fear that the downstream front end of the storage portion-side roll paper falls into any ink reception groove **35** even when the operation of rewinding the roll paper P is performed. Thus, there is no fear that the roll paper P is contaminated with ink adhering to the ink reception groove **35**. In addition, the downstream front end of the storage portion-side roll paper is surely brought into close contact with the conveyance belt **33**. Thus, the storage portion-side roll paper can be prevented from being separated from the conveyance belt **33** to thereby touch the ejection surfaces **13***a*. As a result, ink can be prevented from adhering to the storage portion-side roll paper, and the ejection surfaces **13***a* can be prevented from being injured.

EXAMPLE 2

Next, a second example of the invention will be described with reference to the drawings.

An inkjet printer **100** according to this example has the same configuration as the inkjet printer **10** according to Example 1, except the following point. Parts corresponding to those in the inkjet printer **10** are denoted by the same reference numerals correspondingly, and description thereof will be omitted.

The inkjet printer **100** according to this embodiment is different from the inkjet printer **10** according to the example 1 in that the second paper sensor **18** is not provided; that programs and data, which are stored in the ROM **72** and operate the CPU **71**, are different; and that a control method used in the printing operation is different. Accordingly, the following description will be made on the assumption that the ink-jet printer **10** according to the example 1 excluding the second paper sensor **18** is replaced by the inkjet **100** according to this example, and the programs and data, which are stored in the ROM **72** and operate the CPU **71**, are different from those in the example 1.

In the example 1, as described previously, the roll paper P is cut at the first cutting position C after an image is formed on the roll paper P, and the second cutting operation is performed when the first cutting position C is located in the predetermined region RS including the ink reception groove **35** at the time of rewinding. In this example, before the roll paper P is fed out onto the conveyance belt **33** by the paper feed roller **15**, the first cutting position C is determined based on the length of an image to be printed on the roll paper P, and the driving timing of the paper feed roller **15** is controlled to prevent the first cutting position C from being located in the predetermined region RS of the conveyance belt **33**. Incidentally, in this example, the first cutting position C is set as a position where the roll paper P is cut upstream in the medium feed direction with respect to the region where the image is formed in the roll paper P after the image formation. In addition, when there are a plurality of images, the first cutting position C is set upstream in the medium feed direction with respect to the region where the last image is formed.

The printing operation to be executed by the inkjet printer **100** configured thus will be described with reference to FIGS. **8** to **10** and FIGS. **11**A to **11**C. FIGS. **8** to **10** are operation flow charts schematically showing the printing operation in the inkjet printer **100**. FIGS. **11**A to **11**C are explanatory views observed from the width direction of the conveyance belt **33**, showing the circumstances of the periphery of the paper feed portion **14** at the time of the printing operation. Incidentally, it is assumed that the CPU **71** generates print data including the timing with which ink will be ejected in each inkjet head **12** and so on in advance before executing the printing operation, which will be described below, based on a print instruction signal received through the external interface **86**. In addition, it is assumed that the roll paper P is set beforehand at a position where the roll paper P is in contact with the paper feed roller **15**. Further, in the inkjet printer **100** according to this example, the position of the origin detection sensor **37** is set as follows. That is, when the paper front end D of the roll paper P is located at an initial position E (in this example, the position where the paper front end D faces the first paper sensor **17**), the paper front end D will not be located in the predetermined region RS even if paper feeding is initiated as soon as the origin detection sensor **37** detects the marker **36**. Further, the paper front end D will not be located in the predetermined region RS even if paper feeding is initiated after the conveyance belt **33** moves by a distance as long as the width of the predetermined region RS in the medium feed direction.

Before starting the paper feed operation, which will be described later, the CPU **71** first determines paper feed timing T**1** corresponding to a distance by which the conveyance belt **33** will move after the marker **36** is detected and until the paper feed roller **15** initiates feeding the roll paper P. The paper feed timing T**1** is time (or the rotation step number n of the conveyance motor **77** corresponding to the traveling distance (paper feed start distance) of the conveyance belt **33**) required till the paper feed roller **15** initiates feeding the roll paper P after the marker **36** is detected. The paper feed timing T**1** is determined by the feed control function (feed control unit) of the CPU **71** implemented by the programs and data stored in the ROM **72**.

First, in Step **101** in FIG. **8**, the CPU **71** calculates the image length w (see FIG. **6**), which is the medium-feed-direction length of an image to be formed on the roll paper P, on the basis of the aforementioned print data. Based on the image length w, the CPU **71** calculates a length u from the paper front end D of the roll paper P to the first cutting position C (S**102**). Incidentally, the length u is a length with which predetermined blanks are provided on the upstream and downstream sides of the image length w in the medium feed direction. In addition, the CPU **71** has an image length calculating function (image length calculating unit) and a cutting position determining function (cutting position determining unit) to execute the processing of S**101** to S**102** using the programs in the ROM **72**.

Next, the CPU **71** calculates time Tx (close-contact-position arrival time) required for the first cutting position C to reach a position (first close contact position F) where the first cutting position C is pressed onto the conveyance belt **33** by the first pressure roller **41** (state of FIG. **11**C) after the paper front end D of the roll paper P is located at the initial position E (state of FIG. **11**A) and paper feeding is initiated (S**103**).

Description will be made below on the method for calculating the close-contact-position arrival time Tx. Incidentally, the time TO between the time when the paper front end D of the roll paper P is located at the initial position E as shown in FIG. **11**A and the time when the paper front end D of the roll paper P fed out by the paper feed roller **15** reaches the first close contact position F as shown in FIG. **11**B is stored in the ROM **72** in advance. The length u is divided by the moving rate v (conveyance belt moving speed) of the conveyance belt **33** per unit time, so as to obtain the time required till the first cutting position C in the state shown in FIG. **11**B reaches the first close contact position F as shown in FIG. **11**C. The aforementioned time TO is added to the time u/v obtained thus. Thus, the close-contact-position arrival time Tx can be obtained.

Next, after calculating the close-contact-position arrival time Tx, the CPU **71** identifies the position of the predetermined region RS when the first cutting position C reaches the first close contact position F, that is, when the time Tx has passed since the origin detection sensor **37** detected the marker **36**. The position of the predetermined region RS at the time Tx can be identified in the following method. That is, first, the position can be identified by obtaining the distance by which the conveyance belt **33** moves for the time Tx, which is a value obtained by multiplying the close-contact-position arrival time Tx by the conveyance belt moving speed v. Incidentally, in this example, the predetermined regions RS are set at two places corresponding to the ink reception grooves **35**, respectively. If the position of one of the predetermined regions RS can be identified, the position of the other region RS can be identified because the ink reception grooves **35** are provided at an equal interval on the conveyance belt **33**.

Next, based on the positions of the predetermined regions RS at the close-contact-position arrival time Tx, the CPU **71** judges whether or not the first cutting position C will be located in one of the two predetermined regions RS when feeding the roll paper P is initiated as soon as the origin detection sensor **37** detects the marker **36** (S**104**).

When it is concluded that the first cutting position C will not be located in any predetermined region RS (S**104**: NO), the paper feed timing T**1** is set to be "0" (S**105**). That is, in this example, the idle traveling distance is set to be "0". On the contrary, when it is concluded in S**104** that the first cutting position C will be located in one of the predetermined regions RS (S**104**: YES), the distance k between the first close contact position C and the border R is calculated based on the position of the border R at the time Tx (S**108**). After that, the CPU **71** sets, as the paper feed timing T**1**, the value (k/v) obtained by dividing the distance k by the conveyance belt moving speed v (S**109**). When paper feeding is initiated after the time corresponding to the paper feed timing T**1** (=k/v) has passed since the origin detection sensor **37** detected the marker **36**, the first cutting position C will be opposed just to the border R.

When the paper feed timing T**1** is determined, the CPU **71** first rotates the paper feed roller **15** forward or backward so as to move the roll paper P in order to locate the paper front end D of the roll paper P at the initial position E between the paper feed roller **15** and the position where the conveyance belt **33** is disposed. In Step S**108** shown in FIG. **9**, the CPU **71** judges whether or not the first paper sensor **17** (functioning as a front end detection unit) detects the roll paper P. When the roll paper P is detected (S**108**: YES), the paper front end D of the roll paper P is located on the conveyance belt **33** side with respect to the initial position E. Accordingly, the CPU **71** rotates the paper feed roller **15** of the roll paper P backward by one step (rotates the paper feed motor **79** by one step. The same thing will be applied to the following cases.) (Step **109**), and makes a judgment in S**108** again as to whether or not the roll paper P is detected. The CPU **71** repeats the processing of S**108** to S**109** till the first paper sensor **17** detects the roll paper P.

When the roll paper P is not detected in S**108** (S**108**: NO), the paper front end D of the roll paper P is located on the paper feed roller **15** side with respect to the initial position E. Accordingly, the CPU **71** rotates the paper feed roller **15** forward by one step (S**110**). After that, the CPU **71** judges whether or not the first paper sensor **17** detects the roll paper P. When the roll paper P is not detected (S**111**: NO), the paper front end D of the roll paper P is regarded as still located on the paper feed roller **15** side with respect to the initial position E. Thus, the CPU **71** returns to the processing of S**110**. On the contrary, when the first paper sensor **17** detects the roll paper P (S**111**: YES), the paper front end D of the roll paper P is regarded as located at the initial position E. Thus, the CPU **71** advances to the processing of S**112**. Incidentally, in this example, the initial position E is a position where the first paper sensor **17** detects the paper front end D. The initial position E may be provided desirably between the first paper sensor **17** and the first close contact mechanism **40**.

In S**112**, the CPU **71** moves down the first arm **42** so that the pressure roller **41** of the first close contact mechanism **40** is located at a position where the pressure roller **41** presses the conveyance belt **33**.

After the first arm **42** moves down, the CPU **71** rotates the conveyance motor **77** forward to rotate the conveyance belt **33** forward in order to convey the roll paper P in the medium feed direction (S**113**). After that, the CPU **71** monitors the detection signal of the origin detection sensor **37** as to whether or not the marker **36** provided in the conveyance belt **33** has passed a detection position G (S**114**). In this event, the CPU **71** resets the rotation step number n of the conveyance motor **77** stored in the RAM **73** to be "0". Based on the rotation step number n of the conveyance motor **77**, the CPU **71** calculates the traveling distance of the conveyance belt **33** after the origin detection sensor **37** detects the marker **36**. Thus, the CPU **71** identifies the position of the ink reception groove **35**.

When the origin detection sensor **37** detects the marker **36** in S**114** (S**114**: YES), the CPU **71** sets a timing counter t to be "0" and starts counting (S**115**). The CUP **71** monitors the timing counter t as to whether or not the timing counter t reaches the paper feed timing T**1** (S**116**).

When the timing counter t is identical to the paper feed timing T**1** (S**116**: YES), the CPU **71** rotates the paper feed motor **79** forward (S**117**). When the paper feed motor **79** rotates forward, the roll paper P is fed out from the roll paper cassette **20** by the paper feed roller **15** so that the paper front end of the roll paper P is fed onto the conveyance belt **33**. In such a manner, the timing with which paper feeding is initiated after the origin detection sensor **37** detects the marker **36** is controlled based on the paper feed timing T**1**, so that the roll paper P is cut at the first cutting position C and rewound. In this event, the first cutting position C can be surely prevented from being located in the predetermined region RS.

The roll paper P fed by the paper feed roller **15** reaches the first close contact position F while facing the conveyance belt **33**. When the roll paper P reaches the first close contact position F, the roll paper P is pressed onto the conveyance belt **33** by the first pressure roller **41** so as to come into close contact with the conveyance belt **33**. Incidentally, the paper feed roller **15** is controlled to stop at the time (time Tx) when the first cutting position C reaches the first close contact position F.

As soon as the roll paper P conveyed on the conveyance belt **33** reaches the image formation start position, the CPU **71** drives the inkjet heads **12** based on the aforementioned print data so as to form an image while conveying the roll paper P (S**118**).

After the image formation process by the inkjet heads **12** is terminated, the CPU **71** monitors the first cutting position C as to whether or not the first cutting position C reaches the cutting position H, in order to cut the roll paper P at the first cutting position C and discharge it to the discharge portion **19** (S**119**).

When the front end of the roll paper P reaches the position where the release plate **39** is disposed, the roll paper P is released from the conveyance belt **33** by the release plate **39**, and fed out to the cutting position H as it is. When the first cutting position C of the roll paper P is conveyed to the cutting position H (S**119**: YES), the CPU **71** stops the conveyance belt **33** (S**120**), and the roll paper P is cut at the first cutting position C (S**121**).

After the roll paper P is cut at the first cutting position C, the roll paper (storage portion-side medium, which will be hereinafter referred to as "storage portion-side roll paper") on the retraction cassette **20** side with respect to the first cutting position C is rewound in an opposite direction to the medium feed direction by the backward rotation of the conveyance belt **33** based on an instruction from the CPU **71**.

When the storage portion-side roll paper is rewound after the operation of cutting the roll paper P is terminated, the CPU **71** moves down the second arm **52** so as to allow the second pressure roller **51** to press the roll paper P onto the conveyance belt **33** (S**122**). Thus, of the storage portion-side roll paper, the portion released from the conveyance belt **33** is brought into close contact with the conveyance belt **33** again. The CPU **71** moves up the first arm **42** so that the first pressure roller **41** leaves the conveyance belt **33** (S**123**).

Next, the CPU **71** rotates the conveyance motor **77** backward so as to rotate the conveyance belt **33** backward (S**124**). In this event, as described previously, the storage portion-side roll paper released from the conveyance belt **33** is brought into close contact with the conveyance belt **33** again by the second pressure roller **51**.

When the conveyance belt **33** begins rotating backward, the CPU **71** monitors the first cutting position C (downstream front end) of the storage portion-side roll paper as to whether or not the first cutting position C has been rewound by a predetermined distance to be located upstream in the medium feed direction with respect to the first close contact position F (S**125**). When the first cutting position C has been rewound by the predetermined distance (S**125**: YES), the CPU **71** stops the conveyance belt **33** (S**126**), moves up the second arm **52** (S**127**), and terminates the printing operation.

With the aforementioned procedure, in the inkjet printer **100** according to this example, there is no fear that the downstream front end of the storage portion-side roll paper falls into any ink reception groove **35** even when the operation of rewinding the roll paper P is performed. Thus, there is no fear that the roll paper P is contaminated with ink adhering to the ink reception groove **35**. In addition, the downstream front end of the storage portion-side roll paper is surely brought into close contact with the conveyance belt **33**. Thus, the storage portion-side roll paper can be prevented from being separated from the conveyance belt **33** to thereby touch the ejection surfaces **13***a*. As a result, ink can be prevented from adhering to the storage portion-side roll paper, and the ejection surfaces **13***a* can be prevented from being injured.

Although the preferred embodiments and examples of the invention have been described above, it should be understood that the invention is not limited to the embodiments and examples. Modifications to the embodiments and examples can be made suitably.

For example, various methods can be used as the method for controlling the printing operation to be carried out by the CPU **71**. The procedures or calculating expressions shown in the flow charts used in the aforementioned explanation do not always have to be used.

Although the marker **36** (origin) is detected to identify the position of the predetermined region RS in the aforementioned embodiments, the invention is not limited to this method. For example, the position of the ink reception groove **35** may be detected and identified by a sensor for detecting the thickness of the conveyance belt **33**.

The predetermined region RS, which is set not to allow the downstream front end of the storage portion-side roll paper to be located therein in the rewinding operation, may be set in a range including at least the ink reception groove **35**. The range of the predetermined region RS can be changed in accordance with the convenience of design. It is, however, preferable to set the predetermined region RS to have a certain degree of width at least on the downstream side of the ink reception groove **35** in the medium feed direction.

Although the ink reception groove **35** has a groove shape with a bottom in the aforementioned embodiments and examples, an opening portion penetrating the conveyance belt **33** may be provided in the bottom.

The shape of the ink reception groove **35** viewed in a direction perpendicular to the outer circumferential surface of the conveyance belt **33** does not have to be rectangular as in the embodiments if it is a shape capable of surely receiving ink at the time of flushing operation. In this case, the range of the predetermined region RS has to be set to include at least a range between the most upstream edge and the most downstream edge of the ink reception groove **35** in the medium feed direction.

Both the first and second close contact mechanisms **40** and **50** press rollers onto the conveyance belt **33** to thereby bring the roll paper P into close contact with the conveyance belt **33**. However, their configurations are not limited especially if they are mechanisms capable of bringing the roll paper P into close contact. For example, the close contact may be achieved using the air pressure.

Without using the conveyance belt for conveying the roll paper P, for example, the roll paper P maybe carried and conveyed on the outer circumferential surface of a drum body whose surface is adhesive.

The embodiments and examples have been described on the case where an inkjet printer is used as image forming apparatus by way of example. The invention is not particularly limited thereto, but may be applicable to image forming apparatus in which a long continuous medium is conveyed on a conveyance belt having adhesiveness, and rewound after printing.

The invention is applicable to apparatus having an image forming function, such as an inkjet printer or a facsimile machine, in which ink is ejected onto a long printing medium such as roll paper so as to form an image, and ink is ejected onto a conveyance belt so as to perform a flushing operation. The invention has industrial applicability.

What is claimed is:

1. An inkjet printer comprising:

an inkjet head that ejects ink onto a printing medium to form an image thereon;

a conveyance belt that defines on an outer circumferential surface thereof a groove extending in a direction intersecting with a conveyance direction;

a conveyance mechanism that drives the conveyance belt to travel in the conveyance direction and in a direction opposite to the conveyance direction;

a cutting mechanism that is disposed downstream in the conveyance direction with respect to the conveyance belt and cuts the printing medium;

a control unit that controls at least the conveyance mechanism and the cutting mechanism; and

a judgment unit that, after the cutting mechanism cuts the printing medium, judges whether or not a cut position of the printing medium will be located in a predetermined region of the conveyance belt if the conveyance mechanism drives the conveyance belt to convey the printing medium in the direction opposite to the conveyance direction, wherein:

the predetermined region of the conveyance belt includes the groove;

when the judgment unit judges that the cut position of the printing medium will be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing medium on the conveyance belt in the conveyance direction and subsequently controls the cutting mechanism to cut the printing medium; and

when the judgment unit judges that the cut position of the printing medium will not be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing medium on the conveyance belt in the direction opposite to the conveyance direction.

2. The inkjet printer according to claim **1**, wherein when the judgment unit judges that the cut position of the printing medium will not be located in the predetermined region or the cutting mechanism cuts the printing medium twice, the control unit controls the conveyance mechanism to convey the printing medium on the conveyance belt in the direction opposite to the conveyance direction.

3. The inkjet printer according to claim **1**, further comprising:

an origin detection sensor that faces the outer circumferential surface of the conveyance belt, wherein:

the conveyance belt includes an origin thereon;

the origin detection sensor detects the origin of the conveyance belt; and

after the cutting mechanism cuts the printing medium, the judgment unit judges based on a detection result of the origin detection sensor whether or not the cut position of the printing medium will be located in the predetermined region if the conveyance mechanism drives the conveyance belt to convey the printing medium in the direction opposite to the conveyance direction.

4. The inkjet printer according to claim **3**, further comprising:

a storage unit that stores a first distance and a second distance, wherein:

the first distance represents a travel distance of the conveyance belt from a first timing to a second timing in a case where a to-be-cut position of the printing medium is located on an upstream end of the predetermined region in the conveyance direction during the to-be-cut position of the printing medium being on the conveyance belt;

the second distance represents a travel distance of the conveyance belt from the first timing to the second timing in a case where the to-be-cut position of the printing medium is located on a downstream end of the predetermined region in the conveyance direction during the to-be-cut position of the printing medium being on the conveyance belt;

the first timing is a timing at which the origin detection sensor detects the origin of the conveyance belt;

the second timing is a timing at which the to-be-cut position of the printing medium reaches a position where the cutting mechanism cuts the printing medium;

the judgment unit includes:

a distance calculation unit that calculates a travel distance of the conveyance belt from the first timing to the second timing;

when the travel distance calculated by the distance calculation unit is in a range of the second distance to the first distance, the judgment unit judges that the cut position of the printing medium will be located in the predetermined region if the conveyance mechanism drives the conveyance belt to convey the printing medium in the direction opposite to the conveyance direction.

5. The inkjet printer according to claim **4**, wherein:

the control unit includes:

a subtraction unit that subtracts the travel distance calculated by the distance calculation unit from the first-distance to obtain a subtraction result;

when the judgment unit judges that the cut position of the printing medium will be located in the predetermined region, the control unit controls the conveyance mechanism to convey the printing mechanism on the conveyance belt by at least the subtraction result in the conveyance direction and subsequently controls the cutting mechanism to cut the printing medium.

6. The inkjet printer according to claim **3**, wherein:

the conveyance belt includes a to-be-detected member at the origin thereof; and

the origin detection sensor detects the to-be-detected member to detect the origin of the conveyance belt.

7. The inkjet printer according to claim **1**, further comprising:

a storage portion that rolls and stores at least a part of the printing medium; and

a first close contact mechanism that is disposed upstream in the conveyance direction with respect to the inkjet head and brings the printing medium into close contact with the conveyance belt, wherein:

the conveyance belt is an endless type conveyance belt and has an adhesiveness due to which the printing medium is closely contactable with the conveyance belt;

the conveyance direction heads from the storage portion to the inkjet head; and

the control unit includes:

a first cutting control unit that controls the cutting mechanism to cut the printing medium at the cut position, which is located upstream in the conveyance direction with respect to a region where the image is formed; and

a second cutting control unit that, when the judgment unit judges that the cut position of the printing medium will be located in the predetermined region, controls the conveyance mechanism to convey the printing mechanism on the conveyance belt in the conveyance direction and subsequently controls the cutting mechanism to cut the printing medium.

8. The inkjet printer according to claim **1**, wherein:

the predetermined region includes a region where the groove is defined and an adjacent region having a predetermined width in the conveyance direction.

9. The inkjet printer according to claim **8**, wherein the adjacent region is located downstream with respect to the groove and is adjacent to the groove.

10. The inkjet printer according to claim **1**, further comprising:

a second close contact mechanism that is disposed downstream with respect to the inkjet head and brings the printing medium into close contact with the conveyance belt when the conveyance belt conveys the printing medium in the direction opposite to the conveyance direction.

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